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The CCITT: Organization, U.S. Participation, and Studies Toward the ISDN

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NTIA Report 82-101

The CCITT: Organization, U.S. Participation, and Studies Toward the ISDN

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THE CCITT: ORGANIZATION, U.S. PARTICIPATION, AND STUDIES TOWARD THE ISDN

D. M. Cerni*

The possibility of an Integrated Services Digital Network (ISDN) encircling the globe by the year 2000 is of increasing interest to the worldwide telecommunication community--developers, carriers, manufacturers, and users. Accelerating telecommunication and computer technologies, coupled with the information explosion and parallel market demands for information services, are generally seen to be the prime movers. The International Telegraph and Telephone Consultative Committee (CCITT), always concerned with the development of Recommendations which will aid in international telecommunication connectivity, has put its major emphasis during the present study period, 1981-1984, on the ISDN. The U.S. telecommunication industry is showing great interest in the work of the CCITT, anticipating strong effects of the developing standards on the U.S. market. This report presents a survey of the CCITT and of its role in the study and evolution of the proposed, worldwide, telephony-based ISDN.

Key words: CCITT; CCITT Recommendations; CCITT Standardized Services; ISDN; Study Group XVIII; telecommunications; telecommunication standards; U.S. CCITT

1. INTRODUCTION

1.1 Background

1.1.1 The Information Age and the Information Economy

Widely accepted estimates indicate that the amount of information gathered worldwide in the last decade equalled, or even exceeded, all the information collected up to that point in history. The total quantity of information will double, again, within the present decade.

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According to Guiliano (1981), some 60 percent of the U.S. working force are now information workers. He bases his statistic on the following definition:

> (Information work is) the work activity that has as its primary focus creating, understanding, manipulating, storing, retrieving, or communicating the substance of information shared by more than one person.

Those who work with information include, among others: office workers, lawyers, social workers, brokers, educators, scientists, most other professionals, and all government workers!

This information deluge is fueling the information economy. Whole industries have become dedicated to information. Most jobs being created in the United States are information jobs. The proportion of information workers continues to grow as that of manufacturing and farming operatives continues to decline. A specific example illustrates this point: between 1975 and 1980, the number of workers employed in Colorado's electronic industry grew by 216 percent, compared with a growth rate of 30 percent for the state's manufacturing industry as a whole (Times-Call, Jan. 8, 1982). The largest category of payments in the United States are salaries and fees paid to information workers. Data concerning information work and the information economy are approximately duplicated in other developed societies of the world.

1.1.2 The Importance of Telecommunications in the Information Age

The societal benefits envisioned as a result of the electronic information age include substantially improved social conditions ranging from instant health care to increased energy conservation. The proposed benefits, however, are largely dependent upon the ability of telecommunications to provide efficient, user-oriented transport of this information. As advanced digital telecommunication technology develops, there is the growing need to accelerate the applications of this powerful technology to information transport, thereby maximizing the potential benefits accruing from information services. The strongest demands are for digital communication services which will move information faster, more reliably, and more economically than do the traditional, analog-based services.

1.1.3 Relative Cost Advantage of Telecommunications

This demand comes at an opportune time; telecommunications is increasingly more economical. As can be seen in Figure 1 (Ellis, 1980), these decreasing costs have given telecommunications a relative cost advantage with respect to other segments of our economy. The spread of electronics into all major areas and subareas of the economy ensures that this relative cost advantage will not only persist but will intensify in the 1980's for all the present familiar services.

Furthermore, as the cost of telecommunications is decreasing, the more traditional ways of transferring information are becoming more expensive, overburdened, and inefficient. Two examples of these traditional methods are the mail service and newspaper publication. The almost exponential increase in the cost of mail service, coupled with longer delivery time, is a well-known problem in the United States. This is affecting every aspect of society, and solutions are being sought in the field of telecommunications. Newspapers, faced with monumental printing costs, delivery problems, and time constraints, are turning to computerized solutions, even for writing. In addition, the "electronic newspaper", such as that offered by interactive videotex, is considered a partial solution by many.

1.1.4 The Integrated Services Digital Network

One ambitious worldwide approach which attempts to bring together the demand for the proliferating information services, and the transport mechanisms required to meet these demands, is the global Integrated Services Digital Network (ISDN). Among the several international standards-making groups studying the ISDN is the International Telecommunication Union (ITU). The ITU, one of the oldest international groups in the world (117 years), is responsible for international cooperation in telecommunication matters. It is a specialized agency of the United Nations, and its Convention and Regulations have international treaty status.

Mr. M. Mili, Secretary General of the ITU, considers the present time "a moment of exceptional importance" with regard to the vision of this worldwide integration of telecommunication networks. In his address to the 1980 VIIth Plenary Assembly of the International Telegraph and Telephone Consultative

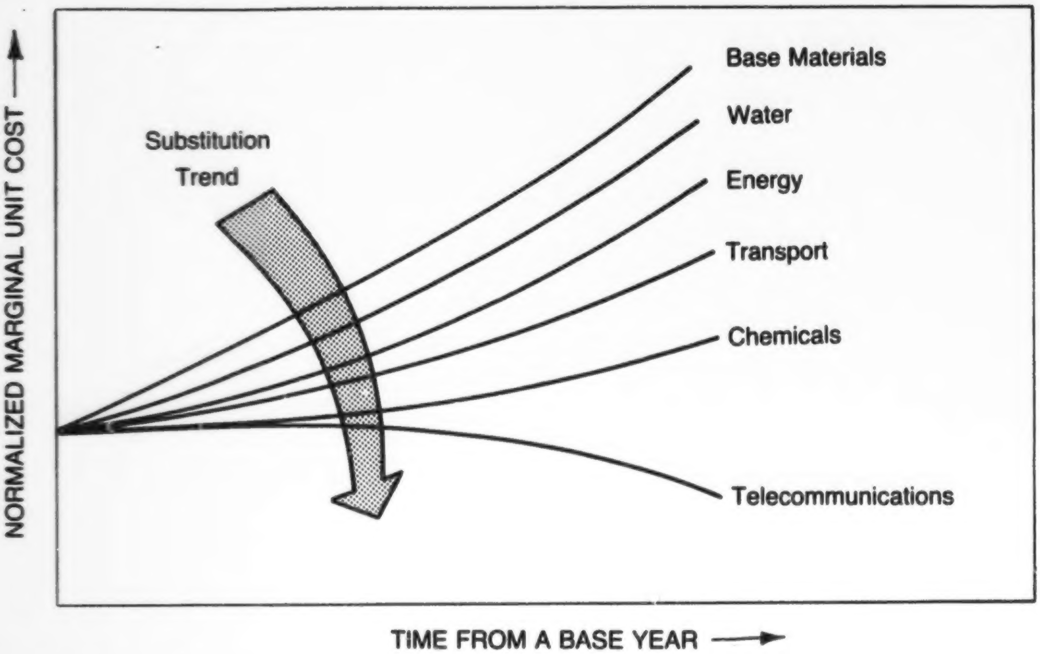

Figure 1. Normalized marginal cost per physical unit of selected resources versus time.

Committee (CCITT), the permanent ITU study committee that is the locus of ISDN studies, Mili underscored two problems that will revolutionize the world telecommunication network in the 1980's. Mili's statement of these two problems is as follows:

> 1) ... the spectacular expansion of all present telecommunication services, which is also to be anticipated with future ones, compels us to rethink the network configuration completely with a view to total integration. ... with the emergence of telematics, consisting of the integration of telecommunications and computers, we are about to embark upon a new and vital phase, namely, the worldwide computerization of society. Data processing techniques will therefore spread even more rapidly than electricity did in the early stages of industrialization. ...
>
> The integration of telecommunication-computer-robot networks, however, cannot be achieved without the worldwide standardization towards which the International Consultative Committees have been working for over half a century. The creation of the computerized society must also be attended by a suitable transfer of modern technology.

> 2) ... the need to respond quickly to the new requirements which are constantly emerging and which call for a speeding up of ... activity to make it possible for equipment fully meeting these requirements to be standardized as soon as possible. (CCITT, 1980, T.D. No. 33)

The solutions to these problems are surely among the most difficult projects ever undertaken by the world community of telecommunication experts in the ITU.

1.1.5 The Interest of the United States in the ISDN

The ISDN topics addressed by the CCITT are of increasing interest to the United States. Formerly, the U.S. telecommunication industry had little motivation for deep involvement in CCITT Recommendation (standards) development. The U.S. markets were chiefly local. However, the increasing internationalization of U.S. trade and the growing interdependence of nations cause the topic of a worldwide digital network to be of great importance to the United States, and emphasize the need for U.S. involvement in international telecommunication standards processes.

1.2 Purpose and Scope

The purpose of this report is to present a summary of the organization and activities of the CCITT, and the U.S. participation in this organization; attention is focussed on the ISDN studies in particular.

The report is directed, in general, to the telecommunication (or computer) expert--engineer, regulator, manager, or user--who is unfamiliar with the CCITT and with its process of Recommendation development. It is directed, in particular, to the reader who wished to become more deeply involved in CCITT matters.

The CCITT Recommendations dealt with in this report are discussed in a general way, and no attempt is made to offer technical details. The discussions presume the reader's familiarity with the technologies involved.

Related topics considered in this report include: the U.S. telecommunication market; the history, structure, and world significance of the ITU; the growing interdependence of the ITU and other international groups, such as the

International Organization of Standards (ISO); and the changes produced in CCITT Recommendations with the accelerating telecommunication and computer technologies.

Some other aspects of ISDN studies, which will influence the development of any global network, are:

1) Political issues: Can each country's security, self-reliance, and right to privacy be guaranteed, while national sovereignty bends somewhat to international cooperation? Will the internal needs of one nation be sacrificed, or even compromised, for those of another, possibly more powerful, nation?
2) Economic issues: Is it cost effective to convert the world's systems into one integrated digital communication line? Will this merely serve to separate further the developed nations, the "haves," from the undeveloped nations, the "have-nots?"
3) International Trade: Will the competitive nature of international telecommunication markets be preserved in this process? In particular, what effect will the standards being developed for the ISDN have on the markets for U.S. telecommunication products and services in other countries?
4) U.S. Domestic Scene: What effect will the recent decisions on telecommunication deregulation, divestiture, and competition in the United States have on the development of a U.S. ISDN? Is the philosophy of the ISDN compatible with the increasingly competitive nature of the U.S. market place?
5) Control: Where is the central control or "intelligence" placed in an ISDN? Basically, who is ultimately responsible for the control, maintenance, and operation of an ISDN?

Although these issues--and others not mentioned--have the power to alter the course of the proposed ISDN in directions not yet anticipated, they are, with few exceptions, not discussed in this report.

1.3 Report Organization

The remainder of this report is divided into seven major sections. Section 2 deals with the ITU, stressing its purpose, structure, legislative foundation, and types of documents. Section 3 discusses the CCITT in detail, with a particular emphasis on the CCITT study groups and the Recommendation process. Section 4 surveys the work of the ITU/CCITT in telecommunication Recommendation development, stressing such developments of the past 2 decades as digital telephony, data networks, and new services. Section 5 outlines the development of ISDN studies in the CCITT, particularly those in Study Group XVIII. Section 6 describes the United States Organization for the CCITT, giving its purpose, membership, structure, functions, and mode of communication with the international CCITT organization. Section 7 complements Section 6 by describing the current participation of the United States in the CCITT. The scope of this participation is indicated by data on attendance at international meetings, written contributions to the study groups, and roles of leadership. A summary of the entire report is offered in Section 8.

2. THE INTERNATIONAL TELECOMMUNICATION UNION (ITU)

The role of the CCITT in world-telecommunication development can best be understood with some knowledge of its parent organization, the ITU. Although the ITU has been eminently successful in harmonizing worldwide telecommunications for over a century, little is known about it in the United States by the general public or even by the technical community. A principal reason for the lack of media visibility of the ITU lies, paradoxically, in its history of success. Issues whose stormy settlement leads to clear-cut winners and losers make headlines; the workings of the ITU do not take place on this kind of battleground, nor are there such winners and losers. The voluntary collaboration of the nations in the study of telecommunication issues has led, instead, to mutual agreement, generally through consensus. Furthermore, since operating methods within the ITU have been designed to function within the limitations imposed by national sovereignties, a flexible, adaptive pragmatism has always prevailed in order to produce the standards required for worldwide compatibility. This desire to come to agreement has forced the acceptance of two (or more) standards in a few instances, but still, there is not much newsworthiness to be found in compatibility.

A brief review of the ITU is presented here, including its history, purpose, structure and types of legislative texts which are published by this organization, including the reasons for the authority that they hold in the international scene.

2.1 Beginnings of the ITU

The initial motivation for international cooperation in telecommunications was the discovery of the electric telegraph in 1837. With the first international transmission in 1849 in western Europe, several problems emerged. Among these were the following:

- Will the electrical devices used in different countries faithfully reproduce the original message?
- How can these messages be transferred across national borders without the necessity of handing them across?
- Will the governments involved in transborder exchange wish to interfere, for whatever reasons, with the exchange of messages? Will privacy be assured?
- What financial arrangements need to be made for the transmission of messages across the border? (Codding, 1952)

These same issues of responsibility and compatibility are very much in the fore today. The solutions of these types of problems have turned out to be the primary objectives of the ITU for 117 years. From its very inception, the main purpose of the ITU proved to be the promotion of compatible telecommunication interconnection between nations.

2.2 History of the ITU

Groundwork for the present ITU was laid in western Europe from 1849-1865, as the States evolved working agreements for international telegraph transmission. The International Telegraph Union was formally founded in Paris in 1865 and its Convention was signed by 20 European States. (The name was not formally changed to International Telecommunication Union until 1944.) In 1875, a revised Convention was agreed upon and it is a tribute to the wisdom of these pioneers in international agreement that a Plenipotentiary Conference did not meet again to revise these Conventions until 1932. The foresight of the drafters of the 1875 Convention is all the more to be admired when one considers that this time period from 1875 to 1932 was a time of extensive technological development, as well as one of world upheaval. Each of the following events demanded increasingly greater international effort:

- discovery of telephone (1876)
- first international telephone connection (1885)
- discovery of radio (1895)
- first international transmission of radio (1906)
- World War I (1914-1917)
- discovery of radar and television (1927-1930)

ITU structure underwent several developments during this period, including the emergence of: the International Radiotelegraph Union and its Convention (1906), the Technical Consultative Committee for Telephony (CCIT) (1924), the Technical Consultative Committee for Telegraphy (CCIF) (1925), and the Technical Consultative Committee for Radio (CCIR) (1927). In 1932, at the simultaneous meetings of the 13th International Telegraph Conference and the 3rd International Radiotelegraph Conference, it was decided that the two Conventions would be formally joined together, giving birth to the new International Telecommunication Union. Telecommunications was then defined as, "Any telegraph or telephone communications of signs, signals, writings, images and sound of any nature, by wire, radio or other system or processes of electric or visual (semaphore) signalling." The first comprehensive Convention was signed by the 80 member countries present at the joint conference. The new Union became truly international, alter-European, at this point, because the 1934 joint-conference marked the first time that the adherence of the United States and Canada to the Radio Regulations was obtained. (The United States and Canada did not actually ratify the Telephone and Telegraph Regulations until 1975.)

Fifteen years later, in 1947, a year that marked the end of a period that had seen the development of atomic energy, World War II, and a concerted thrust toward international cooperation, a major change occurred in the ITU--it became a Specialized Agency of the then newly formed United Nations. The ITU, however, has continued to retain considerable autonomy, because the UN immediately afforded it special status in recognition of the 80 years of international activity prior to 1947. Another important development in 1947 was the formation of the International Frequency Regulation Board whose function it is to deal with the immense problems associated with the allocation of radio spectrum.

In 1948, the Seat of the Union was transferred from Berne, Switzerland, to Geneva, Switzerland. The demographic distribution of the staff (93 percent Swiss in 1948) has continued to show broader distribution with the continued growth of the ITU.

In 1956, the CCIT and CCIF merged to become the present day CCITT. It was in 1956, also, that the first transatlantic cable began carrying traffic; no longer was it acceptable for America and Europe to continue having diverse modes of operation and incompatible technical standards. The CCITT efforts in the 26 years since 1956 have been marked by: rapidly accelerating development of telecommunication Recommendations; increasing acceptance of these Recommendations worldwide; increase in CCITT membership to 155 member nations; the metamorphosis of the CCITT from a "European Club" with European concerns to an international body with worldwide concerns; and an increasing involvement in the needs of developing countries.

2.3 Present-day ITU

The present-day ITU can be understood in terms of its purpose, structure, and legislative texts. This section considers each of these.

2.3.1 Purposes of the ITU

The purposes of the Union are defined in Article 4 of the 1973 International Telecommunication Convention (hereafter referred to as the Convention). These purposes are:

1) To maintain and extend international cooperation for the improvement and rational use of telecommunications of all kinds.
2) To promote the use of technical facilities and their most efficient operation with a view to improving the efficiency of telecommunication services, increasing their usefulness, and making them, so far as possible, generally available to the public.
3) To harmonize the actions of nations in the attainment of these common ends.

The Convention then lists seven methods for carrying out these purposes. These methods deal with radio frequency allocation and registration, efforts to eliminate radio interference, harmonizing the telecommunication facilities development, rate establishment, telecommunication network growth, telecommunication use for safety of life, and telecommunication development. The most significant one for this study on the CCITT is the last: the Union shall "undertake studies, make regulations, adopt resolutions, formulate recommendations and opinions, and collect and publish information concerning telecommunication matters." These activities, exclusive of making Regulations, encompass the actual work of the CCITT. These above points on the work of the CCITT are covered in Section 3.

In general, certain mandates of the ITU derive from the Convention. The ITU, the recognized international specialized organization for telecommunications within the UN family, is responsible for:

1) the international regulation of telecommunications;
2) the establishment of equipment, operational, and tariff (charging) standards and practices;
3) the coordination of telecommunication information for the planning and operation of services, including--through the

Union's Permanent Organs Headquarters--this coordination on a daily basis;

4) the establishment, as necessary, of the global and/or regional "Agreements" in which detailed planning of individual services by each country can proceed with confidence; and
5) the infrastructure development for the effective realization of the telecommunication systems necessary for information and communication transfer within and between nations (Butler, 1980).

In essence, "the primary objective of the ITU is to promote actively the worldwide development of telecommunication techniques and to assist by its actions in the ever-advancing integration of human communication media" (CCITT, 1980, AP VII No. 110).

2.3.2 The Structure of the ITU

The Union is composed of the following organs:

1) The Plenipotentiary Conference;
2) administrative conferences;
3) the Administrative Council; and
4) the four permanent organs of the Union, which are:
   a. the General Secretariat,
   b. the International Frequency Registration Board (IFRB),
   c. the International Radio Consultative Committee (CCIR), and
   d. the International Telegraph and Telephone Consultative Committee (CCITT). (ITU, 1974)

Each of these organs of the ITU is described below.

The Plenipotentiary Conference

The Plenipotentiary Conference is the supreme organ of authority in the ITU and is responsible for laying down the basic policy of the organization. This conference, composed of delegations representing the nations which are members of the Union, meets every 5-9 years. It alone has the power to revise the ITU Convention. Its other activities include the election of the members of the Administrative Council, the Secretary-General, the Deputy Secretary-General, and the five members of the IFRB. The next Plenipotentiary Conference is planned for September to November 1982, in Nairobi. The reader is referred to Codding (1981) for information on this Conference.

The Administrative Conferences

The administrative conferences are generally convened to consider specific telecommunication matters. The world administrative conferences are authorized to revise or amend the Regulations of the Union (see Section 2.3.3). The regional administrative conferences can only discuss specific telecommunication matters of a regional nature.

The Administrative Council

The Administrative Council is a governing body composed of 36 members and meets in Geneva for 3 weeks each spring. It coordinates the work of the ITU, ensuring efficient functioning, particularly from the administrative and financial points of view.

The Permanent Organs

The four permanent organs of the ITU--the General Secretariat, the IFRB, the CCIR, and the CCITT--comprise some 600 staff members. The General Secretariat is directed by a Secretary-General (presently Mr. Mohammed Mili, Tunisia) and a Deputy Secretary-General (presently Mr. Richard E. Butler, Australia). The General Secretariat is responsible for the administration of the Union, the preparation of world conferences, the publication of administrative Regulations and other ITU documents, and the implementation of certain technical cooperation programs. The Secretary-General acts as the legal representative of the Union.

The second permanent organ, the IFRB, is composed of five members who reside permanently at Geneva. The five members are designated by the Plenipotentiary Conference in such a way as to ensure equitable worldwide representation. They meet as needed during the year. Their essential duties are:

1) to effect an orderly recording of radio frequency assignments made by different countries;
2) to effect an orderly recording of positions assigned by countries to geostationary satellites;
3) to advise member nations on the maximum number of radio channels in a given portion of the spectrum;
4) to perform any additional duties which may occur in connection with the radio regulations; and
5) to maintain records of its activities.

The third and fourth permanent organs of the ITU are the two CCI's. The duties of these two groups are:

-- to study and issue Recommendations on technical and operating questions relating to radio communications (CCIR);
-- to study and issue Recommendations on technical, operating and tariff questions relating to telegraphy and telephony (CCITT).

Each CCI elects a Director, who is assisted by a Specialized Secretariat. Participation in the work of the CCI's is open to all member nations of the ITU as well as to certain private telecommunication operating agencies, scientific and industrial organizations and international organizations, which satisfy certain conditions. At the present time, each of these CCI's has been holding its plenary assembly every 4 years. The work of the CCI's takes place in study groups which present their final reports and draft Recommendations to the plenary assembly after 4 years of study. Section 3 is a detailed account of the CCITT.

2.3.3 The Legislative Documents of the ITU

The ITU produces three basic types of legislative (or regulatory) documents to use in governing international telecommunication operations throughout the world. These texts are: the Convention which, together with the General Regulations, forms one integral whole; the Administrative Regulations concerning radio, telephone and telegraph; and the Recommendations of the CCITT and CCIR. Each of these texts emanates from a different world conference, and each is developed through an extensive process of cooperation leading to consensus through discussion. Thanks to this spirit of cooperation, which has existed traditionally among all the specialists who participate in these proceedings, the need to resort to the voting procedure has been rare. Although each of these three types of regulatory documents is evolutionary in nature, and must be to keep pace with telecommunication development, the Recommendations are by far the most dynamic. Section 3 of this report considers the process involved in reaching agreement for Recommendations and their amendments as practiced in the CCITT.

Convention and General Regulations

The Convention is the basic instrument of the ITU and its articles and chapter of General Regulations define the purpose, structure, and overall cations, are dealt with in CCITT Recommendations. Certain Recommendations are referred to in the Regulations. As already indicated, the United States and Canada did not agree to sign the Telegraph and Telephone Regulations until 1975, after certain provisions had been transferred to the realm of CCITT Recommendations.

Recommendations

The third type of published text, the Recommendations, include the technical and operational standards, tariffs, administrative directives, and terminology statements which are drawn up by experts and amended as needed by the plenary assemblies of the CCIR and CCITT. These Recommendations are not binding on the members but do form a very desirable basis for bilateral and multilateral agreements. The Recommendations of the CCITT include such a diversity as the highly technical and detailed 129-page Recommendation covering switched-packet-data networks (X.25) and the one page Administrative Recommendation concerning conceptual principles for the future study of the ISDN within the CCITT (G.705). Although the words "Recommendation" and "standard" have come to be used interchangeably in ordinary parlance, the CCI's issue only Recommendations. (See Mao and Hummel, 1981, for a discussion of this topic.) Certain of these Recommendations, the technical Recommendations, do have the potential of becoming world standards by providing guidance on the best operational methods and techniques to use in the telecommunication network and are considered a major force in this effort. General agreement has been reached in the past that international standards in telecommunications have undoubtedly resulted more from a desire to provide a universal public service than from a concern with the market possibilities. Much more is said about CCITT Recommendations in Sections 3 and 4.

Authority of ITU Documents

In light of the respect for national sovereignty which has always been preeminent in the ITU, where does the "binding power", or authority, of the Convention, and other ITU documents, rest? In the words of Mr. M. Mili, the cations, are dealt with in CCITT Recommendations. Certain Recommendations are referred to in the Regulations. As already indicated, the United States and Canada did not agree to sign the Telegraph and Telephone Regulations until 1975, after certain provisions had been transferred to the realm of CCITT Recommendations.

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Authority of ITU Documents

In light of the respect for national sovereignty which has always been preeminent in the ITU, where does the "binding power", or authority, of the Convention, and other ITU documents, rest? In the words of Mr. M. Mili, the sole authority the Union possesses to ensure that the provisions of its legislative acts are observed is the moral authority of these texts. Mili (1973) states:

> This moral authority, which the ITU enjoys as a result of natural physical laws, particularly the nature of electromagnetic waves, and the fact that in the sphere of telecommunications all countries know that none is an island unto itself, is so strong that to ensure the normal functioning of telecommunication media every country, whether a Member of the ITU or not, finds itself obliged to observe the rules laid down.

Some reasons for the history of voluntary cooperation concerning the ITU are:

- the limited use and resulant isolation of a national telecommunication network which could not be integrated into the global system.
- the harmful interference to other nations which could result if even one nation ignored the Radio Regulations.
- the limited world market if equipment did not conform to the ITU standards (the United States is currently experiencing some of this limitation).

2.4 General Criticism of the ITU

Major criticisms leveled at the ITU in recent years tend to revolve around the monumental issues which separate the developed nations from the developing ones. The radical differences between the "haves" and the "have-nots" appear clearly within telecommunication issues. Vast differences between the developed nations and the developing nations in their telecommunication expertise, economic levels, needs, education, and land use cause the telecommunication development, which is essential for the very survival of a developed nation, to be, at best, only peripheral for a developing nation. The work of the ITU has widened considerably in the past two decades as the member nations have attempted to aid the developing countries, (e.g., through the world plan committees of the CCITT). Illustrative of this problem facing the ITU, and the CCITT in particular, and indicative of the concern of the developed nations, is the following quote from a Canadian contribution to the 1980 CCITT Plenary Assembly:

> The limited participation of Developing Countries in the work of the CCITT Study Groups is due to a number of reasons that are considered beyond the scope of this document. Nevertheless, CCITT

would greatly enhance the results of its studies if it were able to attract an increased participation from Developing Contries to help identify and influence areas of study and thus enlarge the scope, the level of interest and the relevance of CCITT recommendations in a much larger segment of the membership.

Realizing that this is a complex question that has to be considered in broader ITU context, it is proposed that the Plenary Assembly bring this matter to the attention of the next Plenipotentiary Conference for their consideration (CCITT, 1980, AP VII No. 33).

2.5 The Importance of the ITU in the 1980's

The world is looking towards an ever-closer intermeshing through integrated telecommunications. The issues at stake are much too large for any single company or country. Telecommunications can be regarded as the essential infrastructure of the next century--comparable to the railroads and harbors of the 19th century and the highways and airlines of the 20th. The role played by the ITU will become even more vital than it has been.

Brophy (1979) considers that the world will need the voice of the ITU especially in these three traditional areas:

1) it must continue its strong encouragement of the adoption and application, wherever appropriate, of such new technologies as SPC and digital;
2) it must continue to unify the providers of the varied systems, making certain these systems are compatible; and
3) it must continue to adopt standards of system architecture that will allow an orderly evolution of systems. Just as we must not permit absolute standards to block new technology, so we must not allow new standards to force working systems of today into premature obsolescence.

The mission of the ITU has been expanded beyond the wildest imaginings of its founders in 1865, now encompassing the furtherance of a universal, affordable, and global network of integrated telecommunication services.

3. THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE (CCITT)

This section of the report deals with the CCITT, one of the four permanent organs of the ITU. The structure of the CCITT, and its resultant modes of operation, has become increasingly more flexible as the ITU adapts to worldwide technological advances and to increasing demands for telecommunications. Today, the impact of these advances and demands in networks, services, facilities, and customer equipment is affecting all aspects of the work of the CCITT.

3.1 Introduction

The CCITT is particularly affected by the rapidly developing plans for the ISDN--as are many other national and international standards-making groups. The approach being taken by the CCITT in its present restructuring--and, ultimately, in its process of Recommendation development--reveals the importance being placed on rapid formation of ISDN Recommendations. The heavy investment required from any Administration or operating agency in the development of both the "new services" and the equipment leading to the ISDN makes it increasingly important for all international standards organizations, not just the CCITT, to arrive at standardization before implementation. Early standardization, assuring compatibility of the national system with the international network, will help to avoid very costly retrofitting.

To appreciate the role of the CCITT in this regard, it is necessary to understand the working of the CCITT (especially in its study group structure), past and present. This section delineates a) the general organization, purpose, membership, and plenary assembly of the CCITT; and b) the study group structure, including the types of documents, the Recommendation process, and the growth of the study group work. Section 4 considers the effects of accelerating telecommunication and computer technology on CCITT Recommendations and Section 5 discusses some effects of ISDN studies on the CCITT organization.

3.2 The Structure of the CCITT

The CCITT is composed of the following:

1) a Director, presently Mr. L. Burtz of France;
2) a Staff, or Secretariat, of 42 members, who are permanently located at Geneva;
3) an experimental laboratory (since 1927);
4) 15 study groups, whose work is to produce Recommendations;
5) three joint study groups and 2 joint working parties (CCITT/CCIR), whose work is to study topics of common interest to the two CCI's;
6) five plan committees, who develop a general plan for the international telecommunication network, with a particular concern for developing nations; and
7) six special autonomous groups, GAS, who develop technical handbooks for developing nations.

Table 1 lists all of the CCITT groups for 1981-1984, giving the chairman appointed for each at the VIIth Plenary Assembly. Although the work of all the groups listed in Table 1 has an impact on the Recommendations produced by the CCITT, this report will only be concerned with the work of the 15 study groups.

3.3 The Purpose of the CCITT

The general purpose of the CCITT is, simply, to attempt to promote and ensure the operation of international telecommunication systems. This is done by establishing Recommendations for end-to-end performance, interconnection, and maintenance of the world networks for telephone, telegraph, and data communication. Certain tariff principles are established by the CCITT as well. The membership, however, is concerned primarily with the harmonization of the systems from sender to receiver, the end-to-end users (person-to-person, person-to-machine, and machine-to-machine).

In the early days of the ITU (1865-1920), the above purpose was easily fulfilled; international matters were settled at the International Conference. Time was on the side of the member administrations as technological development was relatively slow. The growth of an increasingly complex and rapidly developing technology, starting about 1920, made it clear to the ITU members that future international agreements would have to be based on preliminary studies, tests, and measurements. The three CCI's made their appearance

Table 1. Major CCITT Groups and Chairmen for the 1981-1984 Study Period (Tar, 1981)

Study Group, Joint Working Group, or Autonomous Group	Chairman	Country
STUDY GROUPS:		
Study Group I	K. Freiburghaus	Switzerland
Study Group II	J. Biot	Belgium
Study Group III	M. Kojima	Japan
Study Group IV	J. Kiil	Denmark
Study Group V	G. Gratta	Italy
Study Group VI	K. Nikolski	USSR
Study Group VII	V. C. MacDonald	Canada
Study Group VIII (and XIV)	W. Staudinger	Germany (Fed. Rep.)
Study Group X (and IX)	E. E. Daniels	United Kingdom
Study Group XI	J. S. Ryan	United States
Study Group XII	P. Lorand	France
Study Group XV	D. Gagliardi	Italy
Study Group XVI	S. Munday	United Kingdom
Study Group XVII	V. N. Vaughan	United States
Study Group XVIII	T. Irmer	Germany (Fed. Rep.)
JOINT STUDY GROUPS:		
CMBD	A. P. Bolle (CCITT)	Netherlands
CMMT	Y. Angel (CCIR)	France
CMV	M. Thue (CCIR)	France
PLAN COMMITTEES:		
World Plan Committee	M. Ghazal	Lebanon
Plan Committee for Africa	L. Dia	Senegal
Plan Committee for Latin America	R. J. P. Severini	Argentina
Plan Committee for Asia and Oceania	A. M. Al-Sabej	Kuwait
Plan Committee for Europe and the Mediterranean Basin	L. Terol Miller	Spain
JOINT WORKING PARTIES:		
GM LTG	J. Guillet	France
GM SMM	F. J. M. Jaspers	Netherlands
SPECIAL AUTONOMOUS STUDY GROUPS:		
GAS 3	J. Z. Jacoby	United States
GAS 4	K. Krakowski	Germany (Fed. Rep.)
GAS 5	M. Benedetti	Italy
GAS 7	C. Rudilosso	Italy
GAS 8	G. Malleus	France
GAS 9	L. Ackzell	Sweden

in the 1920's to coordinate these studies, and this role of coordination has escalated in both the CCITT and the CCIR since that time. Another growing role for the CCITT is the exchange and dissemination of technical information, all of which has increasing significance for the developing nations.

Article 11 of the Convention presents the mandate of the CCITT as follows: "The duties of the International Telegraph and Telephone Consultative Committee shall be to study technical, operating, and tariff questions relating to telegraph and telephone and to issue recommendations on them." This report gives the background on three evolving aspects of this mandate: the changing nature of the "study", the expansive growth of the "technical and operating questions", and the increase in the number, nature, and detail of the "recommendations".

3.4 Membership in the CCITT

The issues involved in the rules of membership in the CCITT are assuming greater and greater importance to the participants, especially to the non-administrative members. This subsection deals at length with current concern about membership.

The membership of the CCITT, as stated in Article 11 of the Convention, is offered in full to:

1) the administrations of all Members of the Union.
2) any recognized private operating agency (RPOA) which, with the approval of the Member which has recognized it, expresses a desire to participate in the work of these committees.

A more limited participation is extended to:

3) international organizations and regional telecommunication organizations which coordinate their work with the ITU and whose work is similar.
4) scientific or industrial organizations which are engaged in the study of telecommunication problems or in the design or manufacture of equipment intended for telecommunication services, provided that their participation has received approval of the administrations of the countries concerned.

The number in each of these groups having membership in the CCITT, as of October 1981, was:

1) Administrations	155
2) RPOA's	50
3) International Organizations	32
4) Scientific and Industrial Organizations	137

These last two groups, the international organizations and the industrial groups, are currently the focal points for much of the discussion about the redevelopment of the structure of the CCITT study groups.

3.4.1 Administrations and the RPOA's

Each of the 155 member nations of the ITU has full membership in the work of the CCITT in all its aspects, including the working groups, leadership of all types, and the plenary assembly. Full voting power at the plenary assemblies belongs only to the official Administration delegate or head of the delegation (the U.S., for instance, usually has a 10- to 12-member delegation in attendance headed by a member of the Department of State or an appointed representative). The interests of any particular administration in the technical work of the CCITT is high in those nations where the telecommunications are government controlled. However, in the nations where telecommunications are in the hands of private companies (e.g., the United States) the government participates in the CCITT chiefly through its RPOA's, which have been approved by their respective governments for this role. The RPOA's have full participation in the work of the CCITT--including chairmanship of various types--but do not have voting privileges at the plenary assembly, although they are invited to attend.

3.4.2 International Organizations

The 32 international organizations, which are CCITT members, are invited to participate in the various working groups of the CCITT in an advisory capacity and are permitted to observe the proceedings of the plenary assembly. These international groups fall roughly into two classes: standards groups and user groups.

Standards Groups

Only 2 of these 32 groups, both of which are international standards groups, have specific working arrangements with the CCITT, spelled out in five Recommendations. These two standards groups are the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), both of which are nongovernmental organizations whose sole purpose is the coordination and approval of voluntary international standards of various types, with a growing interest in telecommunication standards. (For a concise treatment of the relationship among the major international standards-making groups, see DeBlasi, 1981, and Lohse, 1981.) The ISO and the CCITT are the two international organizations primarily involved in the development of telecommunication standards. These two organizations have approached the subject of telecommunication standards from different directions--the CCITT from the perspective of communication transmission and the ISO from the perspective of information systems. Over the past few years, because of the merging of technology and common interests, there has been greater overlap between these two organizations. This has been highlighted by activities such as network protocols, open systems interconnection (OSI), codes, text, facsimile, etc. Participants at the VIIth Plenary Assembly noted that the present documentation in the CCITT does not begin to reflect the importance of close coordination on standardization matters which has developed in the past decade and which promises to be of increasing importance in the future, particularly because of the ISDN. This coordination is a current concern and one in which there will be growing involvement by the CCITT (see Section 4.4.3).

User Groups

Several international groups representing users, particularly the International Telecommunications Users Group (INTUG), want fuller participation in the process of Recommendation development and have urged users and administrations to talk to each other. Mr. Richard E. Butler, Deputy Secretary-General of the ITU, stated in an interview: "More and more the interest of the user has to be taken into account as distinct from the evolution of saying 'we know best' which has perhaps been the philosophy of the Administrations and manufacturers in earlier historical days" (Siemen's Review, 1979). The importance of this trend of user participation in the CCITT is illustrated by the invitation to the vice-president of INTUG to address the delegates of the VIIth Plenary Assembly. In his talk, he summed up his concerns:

> INTUG's view of the CCITT is that its success has depended and will continue to depend to a very great extent on the freedom of expression so necessary to good debate. The need to communicate over international boundaries is so clearly vital in this troubled world that it should clearly override purely national or sectional interests. My organiztion therefore views with concern a tendency for individuals and groups to come to the CCITT with already entrenched positions. Such a trend can only undermine the ability of the CCITT to negotiate agreements through the reconciliation of different views. INTUG feels that more flexibility and freedom of expression within the CCITT is necessary to its continuing strength and that all members have a responsibility in this respect. INTUG firmly believes that a healthy CCITT is the right forum for discussions on international telecommunications affairs and ... hopes that in the future the unanimity of user opinion will be reflected more closely by the administrations themselves. Greater sensitivity to national user views could, we suggest, lead to greater unity at the international level ... INTUG intends to play an active role at the CCITT from the beginning of the next study period and hopes that delegates will recognize the value of having direct access to user opinion in their debates (CCITT, 1980, T.D. No. 43).

INTUG also made the following formal proposal to the VIIth Plenary Assembly:

> While it is appreciated that Annex 2, page 135 of the Convention (Malaga-Torremolinos, 1973) provides for a Study Group or Working Group to decide that a meeting, in whole or in part, be limited to Rapporteurs of Administrations and RPOA's, INTUG seeks that this prerogative be exercised with the maximum of discretion so as not to inhibit the exchange of views between Administrations and users so essential to the future of telecommunications (CCITT, 1980, T.D. No. 34).

To emphasize the importance of this to INTUG, a request is then made to the CCITT: "Could a phrase to this effect be added to the rules of the CCITT?" The following quotation from the literature is illustrative of the increasing involvement of the users in the ISO and IEC as well as in the CCITT:

> Because (new services and tariffs) are so user-related, participation by these users in standards writing becomes highly significant. Standards close to the user are written by the ISO committees. Those standards which address safety and environment are in the purview of the IEC and users who frequently participate in ISO

> and IEC. However, these users are also attracted to the CCITT, as well, since the CCITT contemplates much work in new end-to-end communication services. We have seen users trying to participate in writing the various standards to a much higher degree in the last three or four years (Lohse, 1981).

The VIIth Plenary Assembly noted that the increased interest (and it should be added, competition) shown by many international organizations in telecommunication issues (especially in the fields of nonvoice services and data transmission) will necessitate increasingly closer collaboration between the CCITT and these organizations, to minimize the duplication of effort, conflicting results, and even disparity of standards.

The problems facing the CCITT in this regard are clearly expressed by Mr. Burtz, who, in addressing the VIIth Plenary Assembly, said:

> [An important feature to which I should like to refer] ... concerns our relations with various other organizations also dealing with telecommunications, such as ISO, IEC, IMCO, OECD, and UNESCO; the lines of demarcation between the ITU and those other organizations are becoming increasingly blurred which means that collaboration is ever more essential. This is a problem of external relations; the CCITT must continue to make its presence felt in order to uphold the ITU's universally recognized prestige.
>
> Will the CCITT be able to go on ensuring that its authority and expertise are duly recognized in all sectors within its competence, in face of the many initiatives taken by numerous bodies with growing involvement in telecommunications, even though they do not have the major responsibilities which are vested in the ITU as the internationally acknowledged official organization in this field? (CCITT, 1980, T.D. No. 33)

3.4.3 Scientific or Industrial Groups

To date, 137 scientific or industrial organizations (and increasingly manufacturers of equipment as well) belong to the CCITT, pay an appreciable financial contribution for this membership, participate strongly in working groups in an advisory capacity, but are not invited to attend the plenary assemblies. Canada pointed out to the VIIth Plenary Assembly that there is a growing participation of such industrial organizations in the study groups, especially in VII, IX, XIV, XV, and XVIII, and that these organizations are beginning to play a preponderant role. However, it was further noted that some organizations are gradually withdrawing from CCITT studies, where they cannot have full participation, and are transferring to the ISO or IEC where they enjoy full membership status (CCITT, 1980, AP VII No. 124). Therefore, it was proposed that the 1982 Plenipotentiary Conference revise the relevant provisions of the Convention in order to place the scientific and industrial organizations on at least the same footing as the international organizations, thereby permitting them attendance at the plenary assemblies.

3.5 The CCITT Study Groups

The study groups of the CCITT provide the working place for the development of the Recommendations. It is in the study groups that real decisions are made. The questions are examined in order to find the technically correct, and if necessary, the politically palatable Recommendation that will be issued as the basis for international standards.

During the 1977-1980 Study Period, the average number of registered members (organizations, etc.) per study group was 276; this comprises an average of 128 administrations, 50 RPOA's, 17 international organizations, and 81 scientific or industrial organizations.

3.5.1 The CCITT Study Group Structure

The number of CCITT study groups is not fixed, but varies with the work being done in a given study period. During a plenary assembly, some groups are continued (the majority), some are merged to form a new group or a new form of an old group, some are not continued, and new ones may even emerge. The 1977-1980 Study Period included 17 study groups; the 1981-1984 Study Period includes 15.

Participation in Study Groups

The voluntary participants in the study group meetings are termed "rapporteurs" or "experts" by the CCITT. Rules for the registration of participants are set forth in CCITT Resolution No. 1 (CCITT Orange Book I, page 195). (The Resolutions are the rules governing the CCITT operation; a weaker form of a Resolution, approved by a plenary assembly and then published in the CCITT books, is called an "Opinion".) Resolution 1 states in part:

> The Administrations, recognized private operating agencies, and scientific or industrial organizations shall be represented, in the Study Groups and Working Parties in whose work they wish to take

> part, by rapporteurs, appointed by name and chosen by them as experts qualified to collaborate in the search for technically and economically satisfactory solutions to the Questions under study. However, exceptionally, registration with a Study Group, or Working Party, may be made without specifying the name of the rapporteurs concerned. International Organizations shall give the names of their prospective observers.

The average number of attendees at each study group meeting in the last study period was 40.

Study Group Subdivision and the Special Rapporteur

In general terms, each study group, under the direction of a chairman, deals with the questions assigned by the plenary assembly; usually the study group subdivides into smaller groups called working parties. These working parties are under the direction of a study group vice-chairman. Further subdivision may occur within the working party with a particular question, group of questions, or topic being directed by a special rapporteur whose duty it is to oversee, coordinate and communicate the results of the study in its various stages. Correspondence is used as much as possible. Usually, the work of the special rapporteur is finished when agreement is reached concerning the particular assignment. However, the various study groups may use the special rapporteur in slightly differing ways; Study Group XVIII, for instance, assigns a rapporteur to each question, and this person has responsibility for the topic both during the meetings and in-between meetings (although there may not be any tasks to do in the interim). The special rapporteur can also be the chairman of a sub-group, but he remains the special rapporteur during the entire study period.

Types of Study Group Meetings

In addition to voluminous correspondence, several types of meeetings are held by each study group. These meetings include: plenary meetings (the entire study group), working party meetings, meetings called by a special rapporteur, meetings of the special rapporteurs, etc. Although it is the expressed desire of the CCITT to keep these meetings to a minimum (ideally having only one plenary study group meeting and one working party meeting per study period) the 1977-1980 Study Period records 204 meetings for 17 study groups. Fifty-four of these meetings were plenary sessions and the bulk of the remainder were working party meetings. Each study group holds a final meeting towards the end of the study period in order to prepare its final report for the plenary assembly. Until 1972, this final meeting was incorporated into the plenary assembly itself. This is no longer possible because of the growth of CCITT work.

Overall Study Group Structure for the 1981-1984 Study Period

As a direct consequence of the impact of the ISDN, and digital technology in general, on the work of the CCITT, members have been forced continually to re-assess study group structure and functioning in all aspects. Aspects which are considered very important at present are:

- the general need for increased participation in study group work,
- the particular need for increased participation by the developing countries,
- the working methods and action plans of study groups,
- overlapping of work and areas of competence in the study groups,
- the need for collaboration, and
- the desirability of reducing the number of study groups to the absolute minimum.

Relative to the last four points above, the following position was stated by the United Kingdom at the VIIth Plenary Assembly:

> ... priority ... of available resources now needs to be accorded to the work of importance for the international standardization of the networks and the harmonization of customer services ... As necessary, other work should be constrained rather than be allowed to escalate in areas less relevant to the largely digital environment of the future. By keeping the number of study groups to a minimum, problems of coordination are reduced and studies of particular subjects are facilitated by focussing responsibility as far as possible (CCITT, 1980, AP VII No. 107).

The Director of the CCITT pointed out the two conflicting arguments which emerge:

> -- on the one hand, technical development tends towards the establishment of a network common to several services (integrated services digital network), which calls for a combination of studies in a limited number of study groups.
> -- on the other hand, the increasing degree of specialization in the study of the various problems relating to services and networks means allocating the studies to a large number of bodies (Study Groups, Working Parties, and Special Working Parties) (CCITT, 1980, AP VII No. 41).

Plans for the VIIIth Plenary Assembly, to be held in 1984, call for a report on the structure of the study groups and their methods of working. Meanwhile, a medium-term strategy, for the present study period, includes:

- -- the reduction of study groups from 17 to 15;
- -- a distribution of responsibility for the study of various aspects of the ISDN among the ten involved study groups, with Study Group XVIII having coordination responsibility.

Study group structure established for the 1981-1984 Study Period is shown in Table 2. These 15 groups can be clustered into four general areas of study as can be seen in Table 3. Study Group XVIII, which deals with the ISDN in a moderator capacity, is considered in detail in Section 5 of this report; the interrelation of this study group with other groups and organizations which are concerned with the various aspects of the ISDN is discussed also.

3.5.2 Classes of Documents in Study Group Work

Three types of study documents have been used by the study groups in doing their work: contributions, delayed contributions, and temporary documents. The contributions or "white papers" are the official documents, numbered sequentially throughout the study period for each study group, and distributed widely to the interested members. The delayed contributions and the temporary documents are distributed only to the experts in attendance at a specific meeting. During the current 1981-1984 Study Period, a type of contribution that was formerly called a "white paper"--a summary report of a plenary session, working party meeting or special rapporteur meeting--is now printed on yellow paper, and has its own "Report" numbering sequence. Each of these three types of documents--contributions, delayed contributions, and temporary documents--is discussed below.

Table 2. The Titles Designated to the 15 CCITT Study Groups for the 1981-1984 Study Period

Designated Group Number	Title
1. Study Group I	Definition and operational aspects of telegraph and telematic* services (facsimile, teletex, videotex, etc.)
2. Study Group II	Telephone operation and quality of service
3. Study Group III	General tariff principles
4. Study Group IV	Transmission maintenance of international lines, circuits and chains of circuits; maintenance of automatic and semi-automatic networks
5. Study Group V	Protection against dangers and disturbances of electromagnetic origin
6. Study Group VI	Protection and specifications of cable sheaths and poles
7. Study Group VII	Data communication networks
8. Study Group VIII (and XIV)	Terminal equipment for telematic* services (facsimile, teletex, videotex, etc.)
9. Study Group IX (and X)	Telegraph networks and terminal equipment
10. Study Group XI	Telephone switching and signalling
11. Study Group XII	Telephone transmission performance and local telephone networks
12. Study Group XV	Transmission systems
13. Study Group XVI	Telephone circuits
14. Study Group XVII	Data communication over the telephone network
15. Study Group XVIII	Digital networks

*"Telematic" is used provisionally.

Table 3. The CCITT Study Groups Distributed into Four General Fields of Study

Field	Study Groups Involved
Telegraph Telematics Data Transmission	I, VII, VIII, IX, XVII
Digital Transmission Telephone Transmission	XII, XV, XVI, XVIII
Telephone Switching and Signalling Operations Tariffs	II, III, XI
Maintenance Protection	IV, V, VI

Contributions ("White Papers")

Contributions fall into several categories, and chief among these are:

1) working papers submitted by an Administrations or group of Administrations, an international organization, RPOA, or scientific and industrial organization (members of CCITT only). These include technical papers, draft Recommendations, etc.;
2) reports from a special rapporteur summing up the status of a topic;
3) reports or summaries of meetings from other study groups whose work is of interest to more than one study group;
4) reports from other ITU organs, such as CCIR or a joint study group; and
5) statements from the Director or Secretariat of the CCITT.

The first of these, the working papers, is the type of contribution upon which most of the preparatory work and the material for the discussions of the study groups is based, and from the study of which the Recommendations are drafted. These contributions are submitted to the Secretariat in Geneva for translation into the three official ITU languages (English, French, and Spanish) and subsequent distribution to the members who have formally expressed interest in the specific study group. These papers are distributed in sufficient time so that they can be read before an upcoming meeting; the contributions are required to be in Geneva at least 3 months before a scheduled meeting date. In reality, not all of these reach Geneva in time for translation but if there is still time for reproduction and mailing they are sent out as "late" contributions in the language in which they were received. During a given study period, the number of contributions for each study group may reach several hundred and these have varied in length from one page to over 100, with the usual length less than 10 pages. The general directives for the 1981-1984 Study Period, however, request that, "A contribution should not as a general rule exceed about 2,500 words (five pages), nor include more than three pages of figures (making eight pages in all) ... For draft Recommendations and for contributions submitted by Special Rapporteurs, the above directives should not apply" (CCITT, 1981-1984, S.G. XVIII, No. 1).

Delayed Contributions

Delayed contributions are of two types: those which are sent to Geneva as proposed contributions, but which arrive too late even for distribution in the original language as a late contribution; and those which are hand-carried to a specific meeting. In either case, they are reproduced in the language received, and are dealt with during a meeting at the discretion of the study group members involved. Sometimes, in fact, a working party or study group meeting consists chiefly of this type of document. Only the participants of the meeting receive these documents. Formerly, there was no future recourse to them, but starting in 1982, these delayed documents will be numbered sequentially from meeting to meeting, and will be kept on file in Geneva for reference; they will not be available for general distribution. However, if any one of these delayed contributions is considered to be of importance for future deliberations, the Secretariat will either ask the member who submitted it to re-submit it as a contribution or will have it distributed later, as it is, as a numbered contribution. Additionally, items of particular value in these documents normally show up in the meeting report.

Temporary Documents

The third type of document, the temporary document (characterized by a colored front sheet), falls generally into one of two categories:

1) those submitted by the Secretariat, which may be extracts from study group meetings, statements from other international organizations, administrative reports, etc.; and
2) those generated during the meeting itself, which are concerned with such things as agenda, work organization, minutes, and meeting output results. (This last is not a finished copy, for a formal report of the meeting is always submitted to Geneva as a contribution).

Temporary documents of the second type, above, are characteristic of all CCITT meetings, including the plenary assemblies. These temporary documents are "consummable" and are usually of interest only to the attendees during the time of the meeting. Each meeting staff generates its own code for the numbering of these temporary documents. Only the meeting participants receive these documents, and there is no future recourse to them.

3.5.3 The CCITT Recommendation Process

All the aforementioned work of the CCITT study groups is directed to the establishment of Recommendations which will ensure international telecommunication compatibility. This is done through the consultative process, consensus of opinion when possible, and then voluntary application of the resultant Recommendation. Table 4 lists the CCITT Recommendation series.

Recommendation Development and Approval

Recommendation development starts, in theory, with the plenary assembly. This body draws up a list of technical communication subjects, or "Questions" as they are called, the study of which would lead to improvements in international communications. The questions, in practice, are the overflow of work done in the previous study period by the study groups. These questions are then entrusted to the appropriate study group (usually, but not necessarily, the group proposing the question), and are studied in the interval before the next assembly, called a study period. Contributions are solicited from interested members and the study of the questions is considered to be complete when the pertinent study group has found a satisfactory solution, in the form of a Recommendation, amendment, or report, which is acceptable to the members of the group. The plenary assembly, alone, has the power to accept or reject

Table 4. The CCITT Recommendation Series (CCITT, 1980, T.D. No. 78)

Recommendation Series	Title
A	Organization of the work of the CCITT
B	Means of expression (definitions, vocabulary, symbols, classification)
C	General telecommunication statistics
D	General tariff principles
E	Telephone operation, network management and traffic engineering
F	Telegraph operation and tariffs
G	Transmission on lines, radio relay systems, radiotelephone circuits
H	Utilization of lines for telegraphy and radiotelegraphy
J	Radio and television programme transmissions
K	Protection against interference
L	Protection against corrosion
M	Maintenance of telephony circuits and carrier systems
N	Maintenance for sound-programme and television transmission
O	Specification of measuring equipment
P	Telephone transmission quality. Telephone installations and local line networks
Q	Telephone switching and signalling
R	Telegraph channels
S	Alphabetical telegraph apparatus
T	Facsimile telegraph apparatus
U	Telegraph switching
V	Data transmission
X	New data networks
Z	Programming languages for SPC exchanges

the Recommendations and/or amendments presented by the study groups, but in the vast majority of cases the plenary assembly approves the Recommendations as presented, or requires only minor changes.

The Types of CCITT Technical Recommendations

The traditional objective of CCITT technical Recommendations has always been international compatibility with respect to interworking and performance, the goal being always to ensure high quality in international connections for the end-to-end user. The technical Recommendations (also referred to as standards) can be grouped, in general, according to the following three-layer classification:

1) NETWORK INTERWORKING: those that ensure the interworking compatibility of different national networks in that they relate to characteristics which appear, or are implicit, at network interconnection points;
2) EQUIPMENT PERFORMANCE: those that relate to equipment performance, so that the resultant performance of complete international connections meets agreed overall objectives;
3) ECONOMIES: those that lead to economies through greater interchangeability, ease of provisioning, simplification of maintenance, and flexibility of interconnections (Jones, 1979).

The classification above is arranged according to the order of importance which is attached to the various standards. Fortunately, the most vital standards, those in class 1, are the Recommendations least affected by changing equipment technologies. For example, the Frequency Division Multiplexing (FDM) standards, particularly the voice channel frequency spacing and the channel arrangements in the frequency spectrum, have survived several successive technologies. The class 2 equipment-performance Recommendations are being continuously improved, and even replaced, because of new telecommunication techniques. This is increasingly true of the telephone network, as digital switching and transmission replace analog plant. Those Recommendations in class 3 which touch on the engineering specifications in detail are at once the most flexible and the most dispensible. The main purpose of this kind of Recommendation is the prevention of the undue proliferation of equipment designs for a given requirement. Unfortunately, the study of these Recommendations, which is increasing, can easily usurp the time better spent in the consideration of the network itself. For a complete discussion of these above considerations, including the possible inhibiting effects of standards on innovation, the reader is referred to Jones (1979).

The "Interface Standard" Approach

The number of new CCITT Recommendations has increased dramatically in the past decade: 67 in 1972, 127 in 1976, and 204 in 1980. The trend is not only to a greater number of Recommendations, but is also toward greater detail within the Recommendation. Today, not only the outside parameters of systems are specified but also the many internal equipment details that were not previously thought to be within the scope of CCITT study. This trend to internal interfaces continues because many manufacturers now participate directly in the Recommendation process from the beginning, united in the desire to keep internationally approved equipment variations to a minimum.

The tendency now is to concentrate on the interfaces between equipment of systems performing different functions, rather than on the interfaces between networks. Although the interface standard does not attempt to constrain the internal design of equipment, concentrating attention on equipment characteristics that are justifiably standardized but which tended to escape attention with the old approach, the interface approach can unnecessarily engage the CCITT in the pursuit of agreements on minor points for which, in the thinking of some experts, it would be quite acceptable to have alternate recommended solutions or even none (Jones, 1979). Interest is growing in examining the traditional need for a unique solution for every standard because all standards are not equally important to the work being done. Emphasis on the interface standard approach has decreased attention on the interworking of the network itself, and concern about this is often expressed in the CCITT; the interface studies should never be permitted to eclipse the basic need--maximum international compatibility.

Sense of Urgency in Recommendation Development

Although time deadlines have never been assigned to the study of questions in the CCITT, certain questions are now labelled as "urgent"--those studies which should be concluded, or in which significant progress should be made, before the end of the study period. The percent of questions considered to be urgent varies considerably from group to group. Table 5 gives some percents which were tabulated for the present study period as examples. This sense of urgency has been expressed particularly in the work relating to digital networks and the ISDN-related questions. Of major concern is the fact that as the total number of questions studied is increasing, the ratio of questions completed to questions studied is decreasing.

This need for specifying priorities in the order of standard-related studies is born of frustration as well as of market predictions. The question has been asked: "Is there frustration with and within the standards community?" The following answer, although written ostensibly concerning national standards groups, is equally applicable to the international groups:

> Is there frustation with, and within the standards community? Yes! Some frustration is because of conflicting objectives of the affected participants. For example, on any particular project there will be those who feel the urgency to develop a standard quickly--now. Others feel that the technology is not yet ready for a standard and do not want to stifle technological progress. Competition is both inevitable and desirable. Others will say "we don't have time to develop the standard correctly but we must do it now because we will have time to fix it later" ... The process of developing voluntary industrial standards is a delicate process (Vaughan, 1981).

Provisional Recommendations

Because of the rapid pace of telecommunication development, the 4-year period between plenary assemblies can be a very long time to wait for Recommendation approval; the need can arise to have a Recommendation approved before the meeting of the plenary assembly to provide the basis for the continuance of the work of a given study group. To adapt to this type of time

Table 5. The Percent of Questions Considered Urgent for Three CCITT Study Groups (1981-1984)

Study Group	No. of Ques.	No. of Urgent Ques.	% Urgent Ques.
XI	19	2	11
XV	34	6	17
XVIII	19	11	58

constraint, an accelerated procedure for the provisional acceptance of a completed Recommendation is provided in the CCITT Resolution No. 2. A study group may instigate this procedure if there is unanimous agreement to do so by all the administrations and RPOA's attending the particular study group meeting. Approval of the provisional draft of the Recommendation is then sought by the Secretariat according to established procedure. The VIIth Plenary Assembly, in its efforts to maximize this procedure, has required that the "communications should be made in the most effective manner." Definitive adoption of the provisional Recommendation (which is already tentatively in effect) still depends upon its acceptance at the next plenary assembly. Some examples of this are: Recommendation X.75 (Study Group VII), provisionally approved in 1978, was adopted by the VIIth Plenary Assembly; Recommendations V.22 and V.37 (Study Group XVII), provisionally approved in 1979, were also adopted by the VIIth Plenary Assembly. Study Group V requested provisional approval of draft Recommendation K.12 only 3 months after the end of the VIIth Plenary Assembly, in February, 1981. Although only a minority of Recommendations have been processed in this manner in the past, the provisional Recommendation is receiving more interest as a partial response to the need for more rapid conclusions in the work of the CCITT.

Mr. L. Burtz addressed this issue in these words:

> It would ... be extremely desirable to make the accelerated procedure for the provisional approval of Recommendations more flexible, to enable us to keep up with the rapid evolution of technology and meet the criticism, often leveled at us in the past, and still justifiable, that the pace of our work is too slow. The production of equipment by the industrial organizations is to some extent dependent on the standards laid down by the CCITT. It is therefore essential that Recommendations which are deemed urgent and which relate to standards should be circulated and put into effect as rapidly as possible (CCITT, 1980, T.D. No. 33).

3.5.4 Growth of CCITT Study Group Work

Summary of Activities from 1968 to 1980

The extent of the growth of the work of the study groups in the last three study periods can be seen in Table 6. All indications at present point to continued increases in the various aspects delineated.

Table 6. Overall Summary of the CCITT Activities from 1968 to 1980 (CCITT, 1980, AP VII No. 71; T.D. No. 18)

	1968-1972	1973-1976	1977-1980	1981-1984
1. Questions studied	____*	____	332	353
2. Contributions published	2625	4335	6054	7500**
3. Pages reproduced (millions)	____	75.7	89.2	105.3**
4. Meeting days	810	943	1202	1513**
5. Expenditure (Fr. Mil)	____	17.6	25	35.6**
6. New recommendations	67	127	204	____
7. Recommendations substantially amended	199	225	187	____
8. RPOA's taking part	43	46	50	____
9. Industrial organizations taking part	97	119	136	----

* Information not available (1968-1980) or not projected (1981-1984).
**Projected.

Distribution Problems in the CCITT

This growth in the work of the CCITT is manifested clearly in the "paper work" associated with all CCITT activities. It is estimated that 70 percent of the funds are used for this purpose. This subsection surveys some of the current proposals, within the CCITT, to help resolve the growing problem.

A new ITU resolution, No. 847, entitled: "Documents for CCI meetings -- control of volume and observance of time limits for arrival at Union Headquarters for Processing," comprises three main points:

1) Review of the study programme with a view to eliminating those questions for which there is little interest or urgency;
2) Limitation of contributions to those which are absolutely essential for the study of questions and observance of time limits to permit efficient processing; and
3) Search for the best methods of ensuring rapid and efficient distribution of documents (CCITT, 1980, T.D. No. 33).

New contributions of each study group are sent to approximately 1,500 people and the total mailing list for the CCITT is presently about 9,000. Although this number certainly represents monumental work for the headquarters in Geneva, it means, nevertheless, that the documents are not broadly available worldwide. The entire question of quantity of printed material, its availability, and the expense of distribution is one of utmost concern at the present time. The following quote has begun to appear as a footnote in CCITT contributions.

> For reasons of economy, this document is printed in a limited number. Participants are therefore kindly asked to bring their copies to the meeting since no additional copies can be made available.

In addition to endless discussion on how best to reduce the written output from Geneva, several suggestions were made at the VIIth Plenary Assembly concerning this problem. A report from the General Secretariat (CCITT, 1980, T.D. No. 28), states:

> In this regard, greater interest is now being shown on possible alternative means of distributing information such as microfiche, microfilm, or magnetic tape. Most ITU Publications and Service Documents are already prepared with the help of electronic data processing so that the eventual supply of certain information on magnetic tape would create no difficulty ... . Similarly, microfiches are already being used ... for some data ... .

Canada made a draft proposal concerning an experimental ITU text communication and processing system which would provide electronic access for Administration to the CCITT data base (CCITT, 1980, AP VII No. 125). The draft proposes that a system be established in progressive phases with on-line access by members. These phases would be:

Phase 1: with data terminal equipment at ITU headquarters for Member access to the system and access from the ITU headquarters to remote Member data centers both by Members and the Secretariats;
Phase 2: remote access by Member terminals to the ITU Headquarters.

This would be of assistance to CCITT Members in several ways, permitting:

1) timely access to CCITT Provisional Recommendations, and proposed draft Recommendations;
2) exchange of reports of meetings and contributions;
3) distribution of CCITT Circulars and Collective Letters; and
4) temporary on-line data storage for updating draft texts.

In reference to this proposal, Mr. Burtz remarked:

> This is a proposal which should be technically feasible and logical given the nature of our work and the geographical distribution of our members. Firstly, it implies a continuous, or at least a more frequent, updating of the CCITT data base and this could, in fact, be a more logical way to handle our work, avoiding the very heavy load at the end of the Study Period. But there are other facts such as tables, figures or formulae, making on line, real time access impractical (CCITT, 1980, T.D. No. 13).

The solutions to distribution problems in the ITU will not be solved easily, and this issue is within the competence of the Plenipotentiary Conference, not the Plenary Assembly. If, however, the "Medium is the Message", then the comments of Mr. Doran-Deevers, Department of Communications, Canada, are indicative of the future:

> The cost of the materials used is increasing in parallel with the general inflationary spiral. Reliance on the post office by a telecommunications organization is ironic and leads many people to wonder whether it would not be preferable to use telecommunications systems and not the postal service for the distribution of ITU documents. ... for the future long term needs of the Union for dissemination and exchange of information I see no opting but the provision and implementation of a multi-functional data network taking full advantage of such techniques as electronic mail, high-speed printing, interactive videotex, and other services which are just now coming off the drawing boards (Doran-Deevers, 1981).

3.6 The CCITT Plenary Assembly

The work of the study groups is brought to a close at the end of each 3-4 year study period with the presentation of final reports to the plenary assembly. These final reports contain any draft Recommendations and amendments developed by the study group members, as well as general information about the work of the study group and the status of each question. Resolution 1, Part I (CCITT Orange Book I, page 191), details the specifics concerning the plenary assembly.

3.6.1 The Membership of the Plenary Assembly

Invitation to the assembly is offered to all member Administrations, all member RPOA's and to:

> the Director of the CCIR, the United Nations, the Specialized Agencies of the United Nations which reciprocally allow representatives of the Union to attend their conferences, and the other international organizations whose work the Administrative Council considers should be coordinated with the work of the Union and whose activities are similar, to attend the P.A. in an advisory capacity (CCITT Orange Book I, page 191).

As already noted, the scientific and industrial organizations which are members of the CCITT are not invited to attend the assembly in accordance with Nos. 73, 74, and 379 of the ITU Convention.

3.6.2 The Major Tasks of the Plenary Assembly

The major tasks of the plenary assembly include:

1) Organizational tasks:
    a. the review of issues of a general nature, which affect the organization, working methods, efficiency, and activities of the CCITT, and
    b. the formulation of Resolutions, Recommendations, and Opinions based on proposals submitted by member countries, the assembly committees, the Director of the CCITT, officials of other ITU organs, and other participating organizations.
2) Study group issues:
    a. the examination of the final reports of the study groups,
    b. the approval of new and revised Recommendations, and
    c. the selection, approval, and assignment of the questions for the next study period.

3.6.3 The VIIth Plenary Assembly

The VIIth Plenary Assembly, hereafter referred to as VIIth P.A., was held in Geneva in November 1980, and was attended by 515 delegates from 85 Member countries of the ITU, including representatives of 26 RPOA's, and 18 international organizations. Mr. Zoltan J. Tar, a CCITT Staff Member, has written a summary review of the VIIth P.A. for the official ITU publication, Telecommunication Journal. The interested reader is referred to this work (Tar, 1981).

Tar has pointed out several factors, highlighted by the work of the assembly, which are affecting the scope and volume of the CCITT's work. These factors are:

1) The increased interest ... shown by many international organizations in telecommunications issues (especially in the fields of telematics and data transmission) will necessitate increasingly close collaboration between the CCITT and these organizations.
2) The evolution towards an ... ISDN will result in radical changes to the hitherto clearly defined demarcation between the traditional specialized services, which will require close liaison between the CCITT Study Groups concerned as well as with the CCIR and other international organizations.
3) The steps taken by the Plenary Assembly to increase the CCITT's activities in the field of technical assistance to developing countries will place additional duties on the CCITT (Tar, 1981).

In general, the last CCITT study period saw:

1) many refinements in the traditional services,
2) the standardization (first phase) of new non-voice services,
3) important progress in public switched data networks,
4) new specifications on digital techniques and digital networks,
5) the definition of a new signaling system and computer language,
6) the start of studies into optical fibers, and
7) the move away from the demarcation between the specialized services to the concept of the ISDN.

During this time, the basic concepts and parameters relating to digital networks, including the principles of subscriber access, were developed. There is now a good measure of understanding and agreement on the approach to be adopted and, hopefully, this will lead to rapid development in study group work on the ISDN in the 1981-1984 Study Period now in process.

Subsequent to the VIIth P.A., the editors of the Telecommunication Journal decided to make a major effort to disseminate knowledge about the work of the CCITT on a regular basis. Therefore, a special monthly feature, CCITT News, now appears and follows the almost continuous pattern of CCITT meetings throughout the year, summing up the progress being made. This feature reports on decisions made by the CCITT study groups and will, on occasion, dwell on the difficulties facing them as well.

3.6.4 Plenary Assembly Proceedings (CCITT Books)

The proceedings of each plenary assembly are published in a "CCITT Book" which is color coded and multi-volumed. These have come to be called by the color of the cover (e.g., the 1976 "Orange Book" and the 1980 "Yellow Book"). Table 7 gives a summary of the books from the past four assemblies. These books must be published within 1 year of the plenary assembly. A rotating series of colors was fixed at the VIIth P.A. and this will be: red, blue, white, green, orange, and yellow.

The CCITT Yellow Book (1977-1980), consisting of ten volumes, has 30 separate fascicles (books). Starting with the Yellow Book, the entire text of the study group questions will no longer be included, although a list of the questions is offered. This results in an overall savings of 300 pages. The text of the questions, with annexes, will appear only in the first contribution of each study group. Table 8 shows the subdivision of the material in the Yellow Book, as well as the titles, the Recommendations included, and the study groups contributing for each fascicle. These books, separately or as a set, may be purchased directly from the ITU, Geneva, or from the National Technical Information Service (NTIS) in Washington, D.C. The cost of the set is currently about $1,000.

Table 7. The Past Four CCITT Plenary Assembly Publications

Year of Assembly	Location	Color of Book
1968	Mar del Plata	White
1972	Geneva	Green
1976	Geneva	Orange
1980	Geneva	Yellow

3.7 Synopsis

From these pages, the concept of the CCITT emerges as an international forum to which the telecommuncations experts of the world can bring together a plethora of ideas, attitudes, national backgrounds and biases, techniques and technologies; from the widely diverse arena that results, they can forge the standards which the world--by and large--adopts for its telecommunication networks. One outstanding example of their success is direct dial signalling for international calls; it stands as both a symbol of the CCITT itself, and a tribute to the skill of the CCITT members to come to agreement. Building now, on their past success with telephony (and telegraphy), the members of the CCITT are working toward the ISDN.

Table 8. The Subdivisions of the Yellow Book, Giving Contents, Recommendation Series, and Study Group

Volume/Fascicle		Title	Recommendations Included	Study Group
I.	I.1	Minutes and Reports of the Plenary Assembly		
		Opinions and Resolutions		
		Recommendations on: the organization and working procedures of CCITT	A	----
		means of expression	B	----
		general telecommunication statistics	C	----
		List of Study Groups and questions under study		
II.	II.1	General Tariff principles--Charging and accounting in international telecommunications services.	D	III
	II.2	International telephone service--Operation.	E.100-E.323	II
	II.3	International telephone service--Network Management--Traffic Engineering	E.401-E.543	II
	II.4	Telegraph and "telematic services" operations and tariffs	F	I
III.	III.1	General characteristics of international telephone connections and circuits.	G.101-G.171	XV, XVI
	III.2	International analog carrier systems. Transmission media-characteristics.	G.211-G.651	XV
	III.3	Digital Networks-transmission systems and multiplexing equipments.	G.701-G.941	XVIII
	III.4	Line transmission of non-telephone signals. Transmission of sound program and television signals.	H, J	XV
IV.	IV.1	Maintenance: general principles, international carrier systems, international telephone circuits.	M.10-M.761	IV
	IV.2	Maintenance: international voice frequency telegraphy and facsimile, international leased circuits.	M.800-M.1235	IV
	IV.3	Maintenance: international sound program and television transmission circuits.	N	IV
	IV.4	Specifications of measuring equipment.	O	IV

Table 8. The Subdivisions of the Yellow Book, Giving Contents, Recommendation Series, and Study Group (cont.)

Volume/Fascicle		Title	Recommendations Included	Study Group
V.	V.1	Telephone transmission quality.	P	XII
VI.	VI.1	General Recommendations on telephone switching and signalling. Interface with the maritime service.	Q.1-Q.118	XI
	VI.2	Specifications of signalling systems Nos. 4 and 5.	Q.120-Q.180	XI
	VI.3	Specifications of signalling system No. 6.	Q.251-Q.300	XI
	VI.4	Specifications of signalling systems R1 and R2.	Q.310-Q.490	XI
	VI.5	Digital transit exchanges for national and international applications. Interworking of signalling systems.	Q.501-Q.741	XI
	VI.6	Specifications of signalling system No. 7	Q.701-Q.741	XI
	VI.7	Functional Specification and Description Language (SDL). Man-machine language (MML).	Z.101-Z.104	XI
	VI.8	CCITT high level language (CHILL).	Z.200	XI
VII.	VII.1	Telegraph transmission and switching.	R, U	IX
	VII.2	Telegraph and "telematic services" terminal equipment.	S, T	VIII
VIII.	VIII.1	Data communication over the telephone network.	V	XVII
	VIII.2	Data communication networks; services and facilities, terminal equipment and interfaces.	X.1-X.29	VII
	VIII.3	Data communication networks; transmission, signalling and switching, network aspects, maintenance, administrative arrangements.	X.40-X.180	VII
IX.		Protection against interference.	K	V
		Protection of cable sheaths and poles.	L	VI
X.	X.1	Terms and definitions.	----	----
	X.2	Index of the Yellow Book.	----	----

4. CCITT STANDARDIZED SERVICES: THE BASIS FOR THE ISDN

The work of the ITU for the past 117 years has assured worldwide telecommunications in telegraphy and telephony, most often against tremendous odds. During the first 100 pre-digital years, Recommendations were: slow to come about, often polished and refined over several study periods, if needed; written "after the fact," following the establishment of physical plant; and written primarily (if not exclusively) to ensure interconnectibility of the national networks (largely European). As a result, Recommendations were slow to change. The past 2 decades have witnessed a radical shift toward: speed in Recommendation development; increasing concern with details related to interconnectibility, rather than with interconnectibility, per se; and an urgency to have Recommendations, and standards, as guidelines for the design of equipment.

4.1 Introduction

A number of technological and application factors have precipitated changes in the nature of Recommendation development. A main element of the changed climate concerning the required speed of decision making, of course, is the escalating economic scene. The mammoth investment in equipment and plant demanded by the new technologies, as well as the worldwide market trends, will not permit easy remanufacture of equipment according to presently unforeseen and unpredictable new standards. In terms of these technological developments, the digitization of the telephone network, which began in the early-to-mid sixties, can be looked upon as the beginning of these accelerating changes in CCITT Recommendation work, culminating in the present thrust towards the ISDN. In 1965, no one knew that we were heading towards an ISDN; yet, the possibility of an ISDN is a direct consequence (some consider it the inevitable consequence) of the enormous changes which have taken place in telecommunication technology since 1965. The separate and interdependent new technologies and services have been focussed to a common point, not necessarily foreseen in the beginning by the planners and designers. In essence, the work of the past 2 decades in the CCITT has laid the foundation upon which the present studies on the ISDN are being built. It is the demand for digital services which is making the ISDN so very attractive.

The material in this section is written from three perspectives:

1) the CCITT Recommendations of the past 2 decades are a reflection, or record, of the accelerating telecommunication technology of the period;
2) the independent and interdependent technologies--both equipment and service--have converged to form the basis for the ISDN; and
3) the relevant Recommendations, even those replaced or revised, are the foundation upon which the studies of the ISDN can take place.

This section, then, considers:

1) the nature of CCITT standardized services and supplementary services;
2) the historical development of the two basic, traditional CCITT services of telegraph and telephone;
3) the introduction of the data service into CCITT Recommendations;
4) the nature of the three "new services"; and
5) the role of the CCITT in regard to the explosion of services, both standardized and supplementary.

Table 9 (Kirby, 1981) contains a summary of those study areas within the CCITT, which are considered essential to ISDN development. Each of these areas is surveyed in this section.

4.2 Telecommunication Services

Basic to the discussion of telecommunication progress is the meaning of a telecommunication service, and in particular, the concept of a CCITT standardized telecommunication service.

4.2.1 Traditional Concept of Service: Telegraph and Telephone

Prior to the 1960's, the concept of a telecommunication service was straightforward and clear-cut. Telecommunication needs focussed chiefly on only two services: the telephone service--voice over the telephone network--, and the telegraph service--printed messages over the telegraph network. Each of these services became standardized and internationally interconnected. Each service was carried, usually, over its own "dedicated",[1] physically

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[1] CCITT documents commonly refer to a network, reserved for a particular service end to end (whether public or private), as a dedicated network.

Table 9. Recent Accomplishments of the CCITT Essential to the Proposed ISDN

Topic considered	Summary of accomplishments	Study group(s)	Recommendation series
Telephony			
Transmission	All aspects of transmission systems including the media itself, such as symmetric pairs, coaxial cables and optical fibers.	XV, XVI	H, J
Digital transmission	The study of this over all the media has been probably the main area of study during the past decade.	XVIII	G
Digital (Stored Program Control) Exchanges	Specifications are already fixed for the international or toll exchanges and a preliminary draft gives those for local exchanges as well. Three specific languages for designing, programming and maintaining SPC exchanges have been developed.	XI	Q
Signalling Systems	This is one of the most important areas for international standardization. Work is currently being done on signalling system No. 7, the most advanced system so far.	XI	Q
Data Over Telephone	Recommendations of modems, interfaces and maintenance have been established.	XVII	V
Public Data Networks	Many countries are introducing international data networks. CCITT has developed the recommendations for inter-exchange signalling for packet and circuit switched networks and international access plans for public data networks.	VII	X
New Services	The new service policies look toward integration of services over a given network in contrast to the classical philosophy where every service is carried by its own dedicated network.	I, VIII	F, S

continuous public switched network; the two concepts of "service" and "network" were, for all practical purposes, synonymous. In the first century of telecommunications it was both harder and less necessary to distinguish the two concepts than it is today. The providers of these services were (and are) called common carriers, carrying goods (information) to the consumer in the public domain, much as a railroad does. This early, ingrained association of "service" and "network" (or system) adds to the difficulties found today in the narrowing-down of definitions, because the service is the WHAT and the system is the HOW, and it is often difficult to separate the two. Systems provide services, and a service is a set of functions. Wedlake (1980) defines a telecommunication service as "a communications capability offered by the network as seen by the user."

4.2.2 Early Recommendations for Telegraph and Telephone

In the first century of telecommunication standards making, during which time the two services of telegraph and telephone predominated, the role of the ITU was clear: to ensure that each member providing the service, whether governmental or private, would guarantee dependable international communications to the users. In general, if the end-to-end users were satisfied, so was the ITU. The national system and its internal equipment and interfaces were of concern to the ITU only in terms of ascertaining and defining those performance levels high enough for satisfactory international interconnection. Recommendations on a given service were oriented toward the specific network and the organization of the CCI's followed this principle: one committee for telephone (CCIF), and one for telegraph (CCIT).

The most relevant Recommendations of this time period, as might be expected, concerned two main areas:

1) the transmission properties of the entire connection established between the terminal users on each end, including terminal equipments (Series R, S, T, G, and H).
2) the signalling arrangements on international circuits which would be necessary for call set-up, supervision, and release (Series U and Q).

4.2.3 Characteristics of a CCITT Standardized Service

Because of the successful work of the ITU in organizing these Recommendations in the past (and of continually updating them in the present) both of these two traditional international services are characterized by:

1) complete end-to-end compatibility (guaranteed by the Administrations);
2) CCITT standarized terminals, including procedures;
3) listing of the subscribers to this service in an international directory;
4) CCITT standarized testing and maintenance procedures; and
5) charging and accounting rules (Hummel, 1979).

Any telecommunication service studied by the CCITT and identified by the above five characteristics is a "CCITT Standardized Service". The three services of telephony, telegraphy, and data are so classified. The three new services of teletex, videotex, and facsimile are being studied by CCITT and are now classified as standardized services.

The CCITT standardized services are intended to (1) cover the requirements of the majority of the customers, and (2) cut down costs by enabling large-scale production of uniform equipment. Especially in the present day of intense interest in telecommunication services, it is important to emphasize that the goal of the CCITT in developing Recommendations for telecommunication services has not changed: i.e., the ensuring of high quality in international connections for the end-to-end user. Neither the service development (no matter how well done) nor the service standardization (in whatever detail) is an end in itself. These services became significant only when, in response to an expressed need, they are made available to the public.

4.2.4 Importance of Formation of CCITT, Relative to Telegraphy and Telephony

One immense step toward the possibility of an ISDN was the formation of the CCITT in 1956, with the resultant merger of the two separate telephone and telegraph committees (CCIF and CCIT). This has proved to be a fortunate development, for there was a very strong tendency at that time for the two basic services to maintain their own directions and identities. The tendency to individuality was to be permanently reduced, also, by the introduction of data transmission over both of these networks, as well as by the development of digital techniques. All three of these--the formation of the CCITT, data transmission, and digital techniques--have made it essential for telegraphy and telephony to advance hand-in-hand. However, because of the nature of telecommunication development as seen from the perspective of the ISDN, it is the telephone network, and service, which is the core of the material presented below, although the three new services--teletex, videotex and facsimile--are all telegraphy related.

4.3 Development of the Digital Telephone Network

In the late 1950's, one of these two traditional networks began to be used extensively for a third kind of information transport: the analog telephone network was used to transmit digital binary data (which was, of course, suitably modified for passage over the analog system) as well as voice. This proved to be the historical transition into the digital, multi-service world of today, because the multi-purpose network, although still analog, had been born--particularly as an idea in the minds of men all over the world. The concepts of service and network were no longer one and the same.

4.3.1 Digitization of Telephone Network

The story of the modern telephone network is a story of the gradual introduction of digital techniques into a basically analog system. The technology of the various kinds of equipment which make up the telephone network, as well as the information itself that is passed through the network, is classified as either analog or digital. The present telephone network, both as we know it in the United States and that which is found in most countries today, is a combination of both analog and digital equipment, although the relative amount of digital plant differs greatly from country to country. The driving force for conversion is, basically, the economics.

The advantages of network digitization may be summarized as follows:

1) networks suitable for non-telephone services, which are expected to progress in the future, may be established economically;
2) information signals for various kinds of services will be transmitted in the form of pulses enabling integration of communication networks;
3) storage conversion and redundancy suppression will be made easier, resulting in increased efficiency for transmission lines;

4) the number of circuits and transmission speed can be changed according to the destination by means of software, permitting flexible network formation;
5) distortion and noise will not accumulate, making transmission quality independent of distance; and
6) efficient use of circuits can be made through the control of traffic volume by storage or by changing speeds freely during transmission (particularly for non-voice services). (Kitahara, 1980)

The existing telephone network can be briefly summarized as a system which:

1) was developed for voice transmission, only;
2) was totally analog;
3) has been upgraded increasingly in the past 15 years with electronic and digital equipment;
4) is increasingly transmitting voice in digital form; and
5) is being continuously adapted for data, and other non-voice services.

This has led to a public switched network which is used today to support a widening variety of digital non-voice services, such as data and facsimile, as well as voice (presently using about 90 percent of network). The telephone network in the United States is rapidly converting to digital and/or digital-supporting electronic equipment. Table 10, illustrating the proposed penetration of digital (and electronic) facilities into the Bell System by 1990, has been prepared using data from Falconer and Skrzypczak (1981) and from Skrzypczak et al. (1981). (The interested reader is referred to these two articles for a thorough treatment of this material.) Table 10 includes data for 1980 for comparison purposes.

4.3.2 CCITT Recommendations Concerning Aspects of Digital Telephony

The CCITT has been, and is, heavily involved in producing new Recommendations for the digital components of the digital networks which are rapidly replacing the analog networks of the present. The drive for conversion is fueled largely by the economic advantages of digital techniques. The resultant Recommendations will eventually replace the entire complex of Recommendations based on the analog technology.

There are three main areas of CCITT involvement in digital telephony: transmission, switching and signalling.

Table 10. Proposed Digital Plant for the Bell System in 1990, with that in Place in 1980 (data given in percent of total)

	Metropolitan transmission facilities	Local switching	Toll/Tandem switching	Local signalling	Toll signalling (SPC)	Local loop	Long haul
1980	40	40	25	0	85 (1985)	80	1
1990	90	90	92	80	95	90	25

Transmission

Of these three areas, the study of digital transmission has been probably the main area of study during the past decade. Recommendation series G, (Study Group XVIII), contains the relevant Recommendations concerning digital transmission over all media (symmetric pairs, coaxial cable, optical fiber, satellite, etc.).

Switching

Digital switching and signalling, studied by Study Group XI, are covered in the Q series of Recommendations. The stored program control (SPC) exchanges are a critical element of a digital network. Specifications are already fixed in the CCITT for the international exchanges and a preliminary draft gives those for local exchanges as well. In general, "the once sharp distinctions between types of international services have all but disappeared in the evolution of digital electronic switching technology" (Ellis, 1980).

Signalling

The ISDN could not even be conceived without a digital signalling system such as signalling system No. 7, whose specifications were approved by the VIIth P.A. in 1980. The evolution of work done on signalling systems (Study Group XI) is illustrative of the foundation which was set, unknowingly at the beginning, for the ISDN. A brief history of signalling system No. 6 is offered here to illustrate this point.

The continual development of advanced signalling systems is primarily responsible for making intercontinental calling a reality. The implementation of stored program control (and computer memory) made common channel signalling possible. (For a thorough treatment of common channel signalling see Ebner and Tomko, 1979).

Although CCITT signalling system No. 6 was the first of its type in the world to be designed and implemented, it is also the prime example of the increasing danger facing any world standards--the possibility that rapid development of telecommunications and technology will make the Recommendations obsolete almost as soon as they have been officially adopted, even after 4 or 8 years' work (and in this case after 15 years work: 1963-1978).

A particular feature of signalling system No. 6 was that it had been entirely designed by the CCITT, and unlike many of the other specifications, was not merely an international adaptation of an already existing national system. The work proceeded in two stages: system design and field trials. The system design work lasted from 1963 to 1968, when the specifications were submitted to and approved by the IVth P.A. Field trials were conducted from 1969 to 1972 among 11 countries (including the United States) over an enormous area, on a worldwide scale. The final specifications, hardly changed from those accepted in 1968, were approved in 1972 by the Vth P.A., and the system was found to operate perfectly satisfactorily.

Despite all this preparation, the first international telephone connections using signalling system No. 6 did not begin until 1978 and this sytem is now in regular service between the United States, Japan, Australia, and the United Kingdom. By this time, 1978, CCITT experts were already investigating a new standardized digital system, signalling system No. 7, for prospective application between 1985 and 1990, specifically with the ISDN in mind. The specifications were approved by the VIIth P.A. in 1980.

The chief advantage of signalling system No. 6 is that it prepared the way for signalling system No. 7. The studies of signalling system No. 7, with the very ambitious goal of establishing a multiservice signalling system not only for telephony but also for data transmission and for all the public services of the future, have the advantage of a solid foundation based on the standardization of signalling system No. 6 and on the experience acquired with this system. The CCIS System in the United States has been widely implemented for several years, and can be considered a national version of the CCITT signalling system No 6. (For an up-to-date treatment of signalling system No. 6, see Ichihara, 1982.)

4.3.3 Data Transmission over the Telephone Network

The transmission of data over the telephone network served to transfer attention in the CCITT from an almost total concern with nation-to-nation interconnection in the network to a corresponding concern with the interface of the user's data equipment with the telephone network. The V-series of Recommendations (Study Group XVII) were developed in the 1960's and 1970's to standardize the new modems. This work continues, including the study of modems for the new services--teletex, facsimile and videotex. The work of Study Group XVII requires close collaboration with the ISO; more is said about this in Section 4.4.

4.3.4 The Future of the Telephone Network

The modern telephone network--rapidly changed by modern technology, able to handle voice and non-voice services, offering almost instantaneous international connections due, in large part, to universally accepted CCITT Recommendations--is now acknowledged by the CCITT as the basis for the ISDN. Recommendation G.705 (discussed in Section 5) states in part:

> The ISDN will be based on and evolve from the telephony IDN by progressively incorporating additional functions and network features including those of any other dedicated networks so as to provide for existing and new services.

The future role of the entire worldwide telephone network is seen by Theodore Brophy as rapidly evolving. He states:

> ... the new communications technologies offer the opportunity to transcend the goal that dominated telephony for a century. Now there exists the opportunity--indeed the obligation--to achieve another broader form of universal service ... we must set a new goal: the provision of universal, affordable TOTAL COMMUNICATION (Brophy, 1979).

The U.S. telephone industry is indeed gearing up towards this goal, as is evidenced by the following quotation:

> No one can predict exactly what new capabilities the market (of the future) will demand. We do know that data transmission of many types will be increasingly more important, as will all kinds of special services, circuits, and networks. With the flexibility of the Integrated Services Digital Network, the Bell System will be able to support services still to be identified.
>
> It will also support certain continuing Bell System policies (such as) cooperation with national and international standards organizations, so that the Bell System Integrated Services Digital Network will interface gracefully with other networks.
>
> The evolution and shape of the Integrated Services Digital Network will be driven by three forces: technology, economics, and customer demand. All are interrelated. Technology has given us lower-cost digital components that will satisfy new customer requirements. But each force is still separate as well, and in some measure unpredictable. We don't know all the advances in digital technology that await us, or their cost. But the most unpredictable, and perhaps the most exciting, of the three forces is customer demand. No one can be sure of exactly what customers will want. Whatever is needed, however, we believe the flexible Integrated Services Digital Network can accommodate it (Falconer and Skrzypczak, 1981).

4.4 Public Data Networks

Even while the telephone network was expanding in order to accommodate the transmission of data, the new concept of dedicated data networks emerged. The development of data networks took place primarily in order to maximize the use of computers and to share expensive computer resources such as data based, specialized software (computer programs) and the hardware itself. There was a need not only for man-machine communications, but also for computer-computer communications. It was obvious from the very beginning that one, standardized service would never meet the needs of all users.

4.4.1 Beginnings of Data Networks and Study Group VII

Market surveys of late 1960's and early 1970's had predicted that there would be a large rise in the demand for data services operating at data rates far higher than those which could be supported at the time over the public switched telephone network (Wedlake, 1980). Many countries responded to these forecasts of a decade ago by making plans for dedicated data networks and vigorously pursuing studies which, it was hoped, would lead soon to worldwide standardization of the services to be provided and the techniques to be used. The pressures to produce standards for circuit switched operations in the early 1970's are evidence of this interest. The CCITT responded to this pressure by setting up Study Group VII, dedicated to the study of Data Communication Networks, and a new series of Recommendations emerged--the X-series of data transmission over public data networks. Standards have now been agreed upon to an extent where both circuit-switching services and packet-switching services can be provided over their own networks. Both types of services, alone and combined, will most likely have a place in the ISDN.

Two of the best known of the X-series Recommendations are X.21 (1972; revised 1976 and 1980) and X.25 (1976; revised 1980), both of which deal with interfaces for public-data networks. Another significant Recommendation is X.75 (1980) which deals with internet protocols for international packet-switched data networks. This represents a giant step towards the standardization of international interworking. It can be said that the studies of the 1977-1980 Study Period have brought data network Recommendations virtually to the point of completion (aside from quality considerations), and the attention of Study Group VII has largely turned to the place of data networks in the ISDN.

4.4.2 Data Networks and ISDN

The present considerations being made by CCITT concerning the place of data networks in the ISDN is illustrated by the following quotation from a 1981 Japanese (NTT) contribution:

Study has started in CCITT on providing data service utilizing a digital telphone network, taking into account both the inauguration of public data networks in various countries and the digitalization of a telephone network penetrating from transit switches to local switches and subscriber loops.

The digital telephone network will develop as an Integrated Services Digital Network (ISDN), integrating independent public data networks and data services defined by CCITT:

1) First, the ISDN provides local access facilities to a circuit switched data network (CSDN) and will provide data service, which is currently being offered by a CSDN.
2) ISDN provides telephony and data service on a single digital subscriber line.
3) ISDN provides local access facilities to a packet switched data network (PSDN) which offers packet switching service.

Ways to provide data services in the ISDN and ways to integrate public data networks (PDNs) with the ISDN are one of major issues in developing the ISDN. This contribution proposes study items related to the above issues (CCITT, 1981-1984, S.G. VII No. 30).

4.4.3 The CCITT and the ISO

As the customer demands for digital services increase, and as information processing becomes increasingly integrated with communications, the interface problems being studied by Study Group VII are moving closer to the ultimate end user, on the drop side of the DCE. The integrated network of the future must be specified from end to end, and this is forcing the work of the CCITT to be more comprehensive, concerned with equipment details never before considered its domain. The ISO (see Section 3.4.2), always concerned with information systems, is now increasingly involved in telecommunications, and has established "a comprehensive standards framework for incorporating the complex interrelationship between elements of information processing and telecommunications through the development of the Open Systems Interconnection (OSI) model" (CCITT, 1981-1984, S.G. VII No. 28). This, in turn, reflects the increasing CCITT/ISO interdependence. Study Group VII (as well as Study Groups VIII, XI, XVIII and XVIII) is concerned with harmonizing its work with the ISO. Both organizations are being forced to re-evaluate carefully their respective jurisdictions in international standards. Appendices A and B of this report contain two documents which are representative of the efforts towards cooperation of these two prestigious international groups. Moreover, these documents are a further illustration of the internal changes within the CCITT which are being demanded by new telecommunication technology.

4.5 New Services

Fast upon the heels of dedicated data networks was the development of the first of the new services which use some mix of the three established CCITT standardized services--telegraph, telephone, data--as well as video techniques. Before discussing the new services and the CCITT Recommendations concerning these, a distinction is made below between the CCITT standardized services (see Section 4.2.3) and supplementary services or facilities. This distinction becomes helpful in following the CCITT documents, as well as the current literature, which deal with the new services and ISDN development.

4.5.1 Use of the Term, "New Services"

In general, the term "new services" is employed in one of two ways:

1) in specific reference to teletex, facsimile, or videotex (CCITT terminology);
2) in general reference to the increasing number of non-voice, usually digital, services which have evolved from the standardized services with the development of technology.

It is in the latter sense that the words "new services" are usually applied outside of CCITT documents. Various descriptors have been applied to these derived, non-standardized services, and these include:

- special services
- supplementary services
- complementary services
- customer defined services
- facilities
- custom services
- customer defined applications
- user services

These terms are often used interchangeably, even in CCITT documentation. In 1976, the CCITT published a list of 74 possible "supplementary" telephone services (with definitions) which had been prepared by the European Conference of Postal and Telecommunication Administrations (CEPT) (CCITT Orange Book II.2, pp 282-294). These and other non-standardized services complement the

CCITT standardized services, sometimes represent a combination of services, and make use of whatever network is best suited within the country's offerings.

The writers of CCITT documents, however, are very specific in the use of the term "new services", and, in keeping with the concept of a CCITT standardized service, this term almost always refers to one of the three services in No. 1, above, or to a combination of CCITT services. As the development of technology permits more and more interworking of services (hybrids) we hear of the telex-teletex service, the facsimile-teletex service, and the teletex-videotex service. Many services will not stand alone in the future but will increasingly become amalgamated, in whole or in part, with other services.

4.5.2 The Role of the CCITT with respect to all Telecommunication Services

Since the public telecommunication networks now support not only the CCITT standardized services but carry also an important traffic volume originating from customer defined terminals, the role of the CCITT with respect to all services is manifold. According to Hummel (1979), this role includes:

1) CCITT Standardized Services: the CCITT has to describe clearly the standardized services in detail so that interworking between any of the terminals is ensured without the need of conversion in any of the terminals. Standardization includes all those aspects of the terminals which are essential for this goal, leaving hardware or software implementation to the manufacturers so that there is enough room left for competition.

2) The interworking of the CCITT Standardized Services: the CCITT has the task of studying the desirability and possibility of interworking between terminals of different CCITT standardized services. An example is interworking telex-teletex since both services are of the "text communication" type. Interworking teletex-videotex would use the teletex terminal for information retrieval applications and a combined teletex-facsimile terminal would offer the advantages of fast transmission of alphabetic telegraphy and on the other hand, the capability of facsimile to reproduce signature, diagrams, etc.

3) Customer defined services: for customer-defined terminals and applications (banking, information retrieval systems, etc.), the CCITT will have to set out the interconnecting rules and the facilities which can be offered by the network, although administrations are not responsible for end-to-end compatability in this regard. Some examples of these rules and facilities are:

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a. Interconnecting rules:
  - interface recommendations between terminals and circuits
  - the modem Recommendations
  - transmission characteristics of terminals

b. Network facilities:
  - various user data rates of public data networks
  - direct call
  - closed user groups
  - reverse charging
  - packet and datagram facilities

Hummel concludes his remarks on the role of CCITT by stating:

> The distinction between CCITT standardized services and customer-defined services and applications preserves the advantages of the CCITT standardized services for the public at large and, on the other hand, enables a maximum of innovation by both customers and administrations to satisfy new and emerging needs in the domain of non-speech services.

4.5.3 The Three New CCITT Defined Services

The three new CCITT standardized services--teletex, facsimile, and videotex--are all non-voice telegraphy-related services and the definitions of these are the province of Study Group I, formerly entitled, "Telegraph Operation and Quality of Service," but now designated as "Definition and Operational Aspects of Telegraph and Telematic Services[2] (facsimile, teletex, videotex, etc.)." This study group offered the following re-definition of "telegraphy" to the VIIth P.A. (CCITT, 1980, AP VII No. 93). Although it has not been accepted by CCIR and so remains tentative as an ITU definition, it does serve our purpose here:

> Telegraphy is a system of telecommunications that is concerned in any process providing for the transmission, on coded or other forms, of written, printed, or displayed information, or fixed images, however recorded.

This definition is intended by Study Group I to include the three new services. The historical realities which are leading to the integration of services have an ironic twist; although it is the telephone network which now appears to be the core of the future integrated network, of whatever form, there are an increasing number of services to be supplied over this network which found their beginnings in telegraphy. Even so, the term "telegraphy" is falling into disuse.

---

[2] "Telematic Services" has been adopted provisionally by the CCITT, and is applied to such non-voice services as teletex, facsimile and videotex, etc.

The following brief sketches of these services are based on the CCITT study group work.

Teletex

Teletex is a new telegraphy service which offers many sophisticated features combining both certain office typewriter facilities (including editing functions) and transmission functions in order to communicate with remote stations via the public switched network. Teletex is aimed at facilitating and accelerating the exchange of ordinary correspondence. The older form of telegraphy, telex, in service worldwide since the 1940's, is a slow (50 baud) telegraph service which provides a direct interconnection of teleprinters over a public switched network for the exchange of printed messages, taking about 5 minutes for transmittal. There is some concern that teletex will compete with this older, firmly established form of telegraphy. The intent of the CCITT, however, is to promote close cooperation between the teletex and telex services.

Facsimile

Facsimile is the transmission of all forms of graphics, handwritten or printed, from one facsimile machine to another over the public switched network. This service which has been in use in the business community in some form for 100 years, has been called the "sleeping giant" of the telecommunication industry. The number of facsimile terminals in the U.S., estimated at between 100,000 and 200,000 in 1980, is expected to triple by 1985. The reasons for this new interest in facsimile include: (1) the new machines are much faster; (2) some countries already have dedicated facsimile networks permitting easy access; and (3) the characteristics of the facsimile machines have become standardized by the CCITT into three groups, thereby permitting interoperation of the equipment of different manufacturers within the same group. Three additional related services have been tentatively defined by the CCITT: telefax, bureaufax, and datafax. Telefax refers to facsimile transmission, via the telephone network, between customers; bureaufax refers to facsimile transmission between offices or "bureaus"; and datafax refers to facsimile transmission between subscriber stations via public data networks using very high speed terminals (less than 1 minute/page).

Videotex

Videotex is the generic or umbrella term for all systems which transmit text and graphics (stored in some remote data base) to the user's T.V. and which permit the user to have some control over the data viewed. This topic has been dealt with extensively by Bloom et al. (1980). Figure 2 summarizes the terminology predominantly in use in reference to the videotex service and includes the names of representative systems.

The possible future significance of videotex is enthusiastically expressed by a representative from GTE (developers of a new videotex system) in his address to a CCITT symposium on new services:

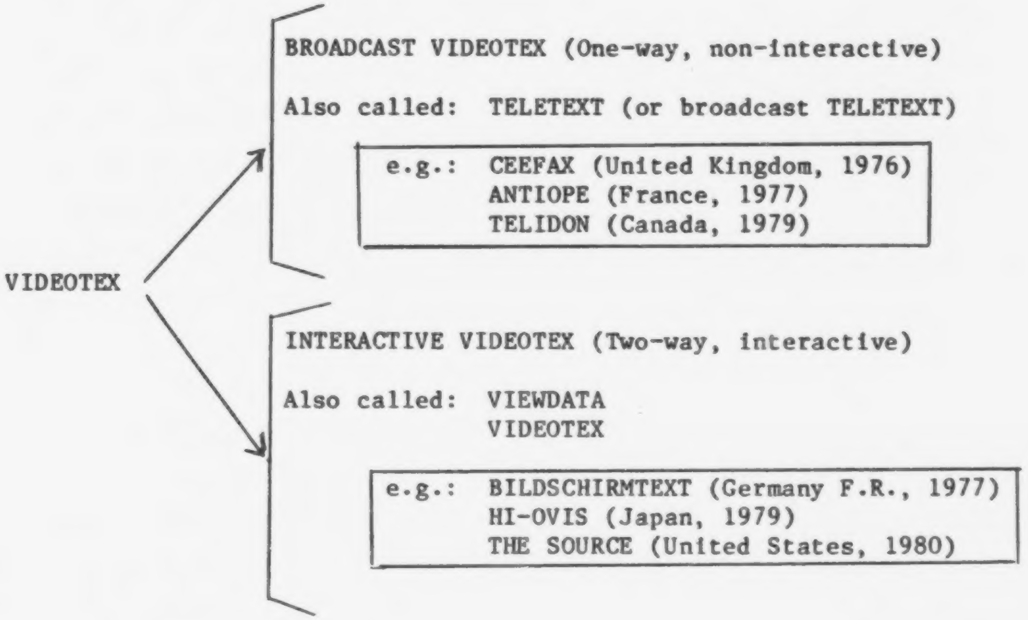
VIDEOTEX
BROADCAST VIDEOTEX (One-way, non-interactive)
Also called: TELETEXT (or broadcast TELETEXT)
e.g.: CEEFAX (United Kingdom, 1976)
ANTIOPE (France, 1977)
TELIDON (Canada, 1979)
INTERACTIVE VIDEOTEX (Two-way, interactive)
Also called: VIEWDATA
VIDEOTEX
e.g.: BILDSCHIRMTEXT (Germany F.R., 1977)
HI-OVIS (Japan, 1979)
THE SOURCE (United States, 1980)

Figure 2. The two modes of videotex service and examples of operating systems.

> At GTE, we believe that the introduction of Interactive Videotex will change the characteristics of our society. The availability of useful information and applications will change the way people perform their daily tasks. This change will result in changes to the local telephone network.
>
> The impact on the local network will be most apparent in the late 1980's when, by one forecast, up to 50 million terminals (in the U.S.) could be utilizing Interactive Videotex services (Berry, 1979).

4.5.4 Five Basic CCITT Recommendations for the New Services

Although the study of these services began only in the last study period, five basic F-series Recommendations, providing terms of reference for these services, were approved in 1980. For facsimile, three Recommendations have been established: the first (F.160) contains general provisions; the second (F.170) concerns the operational aspect of telefax; and the third (F.180) concerns the operational aspects of bureaufax. For teletex, one Recommendation was approved (F.200), and this serves as an essential working base for the continuation of studies and provides the necessary information for the installation of such a service by administrations. For videotex, the one approved Recommendation (F.300) also provides the working base for future studies. This latter Recommendation very carefully sets down no rigid framework for the development of the videotex concept, but sets out broad outlines to be taken into account in further studies.

These five new Recommendations will eventually determine the nature of user interfaces, relative to these services, with the ISDN. The technical aspects of these new services are being studied in other CCITT study groups, particularly in Study Group VIII. Several of these technical S-series Recommendations are already developed (e.g., S.60, S.61, and S.62).

4.5.5 Services and User Applications for the ISDN

Two English authors, Brown and Mason (1981), in an article dealing with services for the emerging ISDN, present a tentative "shopping list" of services and user applications suggesting that an administration or RPOA could select a set of services to meet their own international ISDN requirements. Any set of services thus chosen, they point out, is unlikely to be enduring and will change in response to customer's requirements and advances in technology. This list is offered for the reader's consideration in Table 11.

4.5.6 The Integration of Services in the ISDN

Question 1, Point A, of Study Group XVIII's work program for this study period, is concerned with the service aspects of the ISDN. The network features in the ISDN will be dependent upon the user services and facilities to be integrated in and supported by the ISDN. Wedlake (1980) makes the following distinction between an "integrated service" and an "integrated network:"

> An important distinction must be drawn between two basic forms of integration. The first involves integration as seen by the customer at his interface to the network. He sees a common interface for all his services and utilizes a unified set of control procedures; however, he is unconcerned whether his data and voice services are actually carried on common plant--he enjoys an integrated service.
>
> In its second form the emphasis is placed on the use of common equipment to switch and transmit all services: where fundamentally different customer interface requirements exist common switches could offer specialized interfacing arrangements on particular subscribers' lines. At its core this approach provides an integrated network.
>
> In a practical environment an amalgam of both approaches must be adopted and benefits will be available to customer and Administration alike.

The first of these points, above, the user's perspective, is dealt with in a recent contribution to Study Group XVIII by AT&T. This document is reproduced as Appendix C.

Appendix D contains the entire text (without annexes) of Question 1, mentioned above. More is said about this topic in Section 5.5 of this report.

4.6 Summary

The accelerated pace of telecommunication technology which has occurred within the past 2 decades, and which is continuing unabated, has had its

Table 11. A List of Services and User Applications Potentially Supported by an ISDN (U.K.)

telephony (switched)
circuit switched data
packet switched data
support of Datel V series terminals and interworking with Datel on the PSTN
telex (switched)
teletex (switched)
videotex (switched)
slow-scan television
private circuits (acting as a bearer for other services on a point-to-point basis)
facsimile (switched)
message switching
electronic funds transfer
information retrieval
mailbox
electronic mail
alarms
telecontrol
enhanced network services including protocol conversion
wideband services
telewriting
text communication for the deaf and dumb
telemetry

counterpart in the work of the CCITT Recommendations. In the past they reflected technology; now they are increasingly determining technological applications. And for the future in telecommunications, the user, not the designer or manufacturer, is looked upon as the ultimate controlling factor.

Section 5 takes the material in this section one step further and considers the work of the CCITT on the ISDN itself.

5. THE STUDY OF THE ISDN BY THE CCITT

5.1 Purpose

The preceding materials on the CCITT and on the CCITT Recommendations form the background against which to consider the work of the CCITT on the ISDN, per se. This section outlines the development of Study Group XVIII, and its present program of study. This section has three major objectives:

1) to serve as a dramatic illustration of the evolutionary nature of both the CCITT study group structure (Section 3.4), and the study programs leading to Recommendations;
2) to provide a foundation for Section 7 of this report, which deals with U.S. participation in the CCITT. It will be seen in Section 7 that most U.S. involvement revolves around ISDN issues; and
3) to outline, in a general way, the organization of ISDN studies in the study groups for the reader who wishes to pursue the study of ISDN work in the CCITT.

5.2 Introduction

The idea of the ISDN is still largely in vision and possibility, rather than in existing technical reality. It has, nevertheless, permeated the work of the CCITT study groups. Undoubtedly, ISDN studies are among the most important tasks, if not the most important tasks, facing the CCITT today. According to Tar (1981), "The ISDN is the pointer to the future, the advent of which will have a profound effect on the telecommunication networks of tomorrow." The VIIth P.A. attempted to ensure the ongoing progress of these urgent studies on the ISDN by (1) assigning to Study Group XVIII (Digital Networks) the direct responsibility for the establishment of the ISDN, and (2) confirming Study Group XVIII's role as coordinator in the field of CCITT digital studies.

This section traces the development of ISDN studies in the CCITT by:

1) discussing the evolution of both the structure and the work of Study Group XVIII, from its beginning as Special Study Group D (1968) to the present;
2) outlining the assignment of ISDN studies among ten CCITT study groups (including Study Group XVIII); and
3) examining the work of Study Group XVIII, especially Working Party XVIII/I, concerning the ISDN.

5.3 Evolution of Study Group XVIII

5.3.1 History of Study Group XVIII (1968-1980)

In 1968, the IVth P.A. (Mar del Plata) established Special Study Group D, whose purpose was to study the questions relating to (1) pulse code modulation and (2) the planning of digital systems. Special Study Group D was given full study group status 8 years later by the VIth P.A. (Geneva, 1976). The new study group, Study Group XVIII, is titled "Digital Networks."

Table 12 gives the title of the first question assigned to this group from 1968-1980. The changes in the title, from assembly to assembly, tell the story of the growth of the ISDN concept in the CCITT. In summary, digital systems led to the integrated digital network; the integration of services led to the integrated services digital network. The former refers to the integration of equipment, providing a digital pathway for one service; the latter refers to the use of the integrated network for its specific service and for other services, as well.

The first Recommendations from Special Study Group D concerned PCM and digital multiplex equipment (G.702, G.703, G.711, G.712, etc.).

5.3.2 The Early Work Leading to the ISDN

The main thrust of the early work towards an integrated digital network (IDN), designed for the requirements of one particular service (e.g., telephony), maintained the essence of the CCITT tradition of the dedicated network: one network for one service. The 1972 definition, upon which the IDN Recommendations have been developed, is:

> Integrated digital network; a network in which connections established by digital switching are used for the transmission of digital signals (CCITT Green Book III.2, page 362).

The ultimate goal of the work on the IDN (national and international networks) was the vision, however unclear at the time, of expanding the dedicated digital network(s) to the ISDN, capable of carrying additional services. This second stage in digital development has been based upon this 1972 definition:

Table 12. Question 1 as Assigned to Special Study Group D (1968-1976) and to Study Group XVIII (1976-1984)

Study Period	Title of Question 1
1968-1972	Planning of digital systems
1972-1976	Planning of digital systems and integration of services
1976-1980	Overall aspects of integrated digital networks and integration of services
1980-1984	General network aspects of an integrated services digital network (ISDN)

> Integrated services digital network: an integrated digital network in which the same digital switches and digital paths are used to establish connections for different services, for example, telephony data (CCITT Green Book III.2, page 362).

According to Irmer (1981b), it has been this "two-stage-evolution" principle which has led to the fundamental problems concerning the ISDN:

> ... digital networks established now are throughout the IDN type (e.g., either for telephony or for data). Parameters of such IDN's must support primarily the dedicated service but as far as possible they should also support other services to allow for later transition to the ISDN--although the requirements of many of the so-called "new services" are not yet defined as required.

5.3.3 The 1980 Recommendations of Study Group XVIII

Study Group XVIII, in close cooperation with other study groups, produced several fundamental Recommendations during the last study period. These have not been limited, of course, to evolutionary aspects of the IDN and the ISDN; many technical parameters, required both for today's integrated digital networks and for the ISDN, are offered in several G-series Recommendations. The fundamental Recommendations on the ISDN, including a brief synopsis, are listed below (Irmer, 1981b):

G.705 (1980) Conceptual principles of the ISDN:

-- lists 6 principles upon which to base studies of the ISDN. (Amendments for these have already been proposed; see Section 5.5.1).

G.722 (1980)	Interconnection of digital paths using different techniques: -- newly designed digital transmission systems forming digital paths should be bit-sequence-independent (BSI), thus offering unrestricted operation at 64 kbit/s.
G.704 (1980)	Maintenance of digital networks: -- defines a "maintenance philosophy" and maintenance principles such as "maintenance entity," classes of alarms, methods of transmitting alarms: AIS (Alarm Indication Signal) = "downstream" in direction affected; and UFI (Upstream Failure Indication) = "upstream" in direction non-affected.

The following Recommendations define impairments and their allocations to digital networks (including the ISDN):

G.821 (1980)	Error performance for a 64 kbit/s hypothetical reference connection: -- considers different requirements for telephony and data and attempts to harmonize these requirement. (According to Irmer, this will have to be revised: which bit error structure for which service for which type of connection should form the basis for setting the bit error limit?)
G.822 (1980)	Controlled slip rate objectives for an international connection: -- provisional targets for slip rates: for 64 kbit/s connections, 1 slip/min is "unacceptable;" 1 slip/5 hrs is "acceptable."
G.811 (1976, 1980)	Performance of clocks suitable for pleisochronous operation international digital links: -- defines values for stability and accuracy of reference and non-reference clocks operated in network modes for interconnecting digital links in pleisochronous operation.

This list of Recommendations on the ISDN, and certain ISDN-related studies, illustrates the level of achievement so far reached in the CCITT; the bulk of the work is still ahead! Even so, it is the hope of the CCITT that the fundamental Recommendations for the ISDN will be agreed upon by 1984 (within the framework of G.705). More is said below on the work of Study Group XVIII.

5.4 The ISDN in the Present CCITT Structure

The VIIth P.A., besides assigning to Study Group XVIII the moderating and coordinating roles for the ISDN, also determined the specific areas of responsibility for ISDN studies for nine other study groups. This subsection discusses (1) the organization of the Study Group XVIII, and (2) the other groups involved.

5.4.1 The Organization of Study Group XVIII

Study Group XVIII's organization for the 1981-1984 Study Period is shown in Table 13. The study group chairman and five vice-chairmen (working party chairmen) are listed. The questions, grouped by working party, comprise the 19 questions which were assigned to the study group by the VII P.A. The question title only is given. The reader is referred to the document, CCITT, 1981-1984, S.G. XVIII No. 1, for the complete texts of these questions and all related annexes.

5.4.2 CCITT Areas of Responsibility for ISDN Studies

The nine other study groups having directly assigned areas of responsibility in ISDN studies are Study Groups I, II, III, VII, VIII, IX, XI, XV and XVII.

Chief among these groups are the following three: Study Group VII (Data Communication Networks); Study Group XI (Telephone Switching and Signalling); and Study Group XVII (Data Communication over the Telephone Network). Table 14 lists these responsibilities as assigned by the VIIth P.A. This table, besides providing specific information on the ten study groups directly involved, also indicates the extent of close cooperation required among the CCITT study groups themselves, and with the CCIR and joint study groups.

5.5 Preliminary Work of Study Group XVIII in 1981-1984 Study Period

The task of Working Party XVIII/1, "ISDN", is perhaps the most urgent of all in preparing the way for ISDN Recommendations because it is building the

Table 13. The Five Permanent Working Parties of Study Group XVIII, and Questions Assigned, for 1981-1984 Study Period

Study Group XVIII - Digital Networks
Chairman: Mr. T. Irmer (Federal Republic of Germany)

Question	Title
	Working Party 1 - ISDN Chairman: Mr. H. K. Pfyffer (Switzerland)
1/XVIII*	General network aspects of an Integrated Services Digital Network (ISDN)
2/XVIII	Customer/network interface
6/XVIII	Definition of digital networks
	Working Party 2 - Signal Processing Chairman: Mr. M. Decina (Italy)
7/XVIII	Encoding of speech and voice-band signals using methods other than PCM, in accordance with Recommendation G.711
8/XVIII	Digital speech interpolation system
	Working Party 3 - Network Performance Objectives Chairman: Mr. V. I. Johannes (AT&T, United States of America)
9/XVIII*	General network performance aspects of integrated digital networks
10/XVIII*	Availability for the ISDN
11/XVIII	Characteristics for digital sections
12/XVIII	Maintenance philosophy of the digital network
13/XVIII	Implementation of maintenance philosophy
14/XVIII*	Interworking between digital systems based on different standards

Table 13. The Five Permanent Working Parties of Study Group XVIII, and Questions Assigned, for 1981-1984 Study Period (cont.)

Working Party 4 - Switching and Signalling

Chairman: Mr. B. Roche (France)

3/XVIII	Synchronization in digital networks
4/XVIII*	Signalling of the ISDN
5/XVIII*	Switching for the ISDN

Working Party 5 - Digital Equipments

Chairman: Mr. K. Okimi (NTT, Japan)

15/XVIII	Interfaces in digital networks
16/XVIII	Performance characteristics of PCM channels at audio frequencies
17/XVIII	Characteristics of PCM multiplexing equipment and other terminal equipments for voice frequencies
18/XVIII	Characteristics of digital multiplex equipment and multiplexing arrangements for telephony and other signals
19/XVIII	Network aspects of existing and new levels in the digital hierarchy

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*Urgent questions. Also, questions 3, 6, 12, 13 and 15/XVIII could be considered as urgent questions.

Table 14. The Study of the ISDN as Assigned to the CCITT Study Groups, (1981-1984) Study Period (CCITT, 1981-1984, S.G. XVIII No. 1)

Examination of the Questions drafted by Study Groups III, IV, VII, XI, XVII and XVIII reveals that each Group intends to study various aspects of the ISDN. In order to avoid overlapping and possibly conflicting results the VIIth CCITT Plenary Assembly agreed that the areas of responsibility for the study of ISDN should be assigned as follows:

		Assign to
1.	Services and facilities interpretation and coordination (taking into account the requirements identified by Study Groups I, II, III and VII).	XVIII
2.	General ISDN aspects and guidelines, quality of service, numbering, performance targets, maintenance principles and miscellaneous subjects not more specifically identified (taking into account the requirements of Study Groups I, II, IV, VII, XI, XVII, and CMBD).	XVIII
	Note: It is considered that Items 1 and 2 above are of high priority.	
3.	Digital transmission standards and performance (local and inter-exchange). The study of hypothetical reference connections is in the competence of Study Group XVIII, the study of hypothetical reference digital paths is in the competence of the specialized Study Groups of CCITT and CCIR, the study of reliability and availability is to be coordinated by CMBD.	XV/XVIII
	Note: Also of interest to CCIR.	
4.	Switching aspects and parameters (taking into account the requirements identified by Study Groups VII, XVII and XVIII).	XI
	Note: In the case of mixed mode switches (e.g., ISDN circuit and packet) other Study Groups will also be consulted.	
5.	Inter-exchange signalling system (Message Transfer Part (MTP) and appropriate User Part(s)) (taking into account the requirements identified by Study Groups VII and IX).	XI
6.	Subscriber-exchange signalling system (taking into account the requirements identified by Study Groups I, II, VII and XVII and coordinated by XVIII - see Item 2).	XI

Table 14. The Study of the ISDN as Assigned to the CCITT Study Groups, 1981-1984 Study Period (CCITT, 1981-1984, S.G. XVIII No. 1) (cont.)

			Assign to
7.	Subscriber-network interface		
	i)	Interface B	XI
	ii)	Interface A - Voice services	XI
	iii)	Interface A - Non-voice services	VII/XVII
	iv)	Interface A - Alternate voice/data	VII/XI/XVII
	Note:	Close collaboration between Study Groups VII, XVII and XI will be required to ensure compatibility between 7 i), ii), iii), iv) and the subscriber signalling system identified in 6.	
8.	Interworking (inter-service and inter-network)		
	i)	Data	VII
	ii)	Telex	IX
	iii)	Telephone	XI
	iv)	Data over the telephone network	I/II/XVII
	v)	Teletex	I/VIII
	vi)	Facsimile	I/VIII
	Note:	Collaboration between the Study Groups referred to above will be required to ensure compatibility in the carriage of the various services on ISDN and other networks.	
9.	Digital telephone instrument		XII
10.	Tariff aspects		III

framework within which these new studies will be confined. The limitations set now will, in effect, determine the future of telecommunications.

This subsection focusses on the present studies of this working party by (1) examining the amendments currently proposed to Rec. G.705, and (2) outlining the projected plans of Working Party XVIII/1 for this study period.

5.5.1 Amendments Proposed to Recommendation G.705

Recommendation G.705 (Geneva, 1980)--the "Magna Carta" of ISDN evolution (Irmer, 1981b)--gives the first conceptual principles of the ISDN as promulgated by the CCITT. This Recommendation is reproduced in full in Table 15.

Approved in November 1980, this Recommendation was seen almost immediately as too restrictive in the long term, needing expansion to incorporate further features, such as data packet switching, and to incorporate possible new technologies in the future.

In his address at the International Switching Symposium, held in Montreal, September 1981, Theodore Irmer, present Chairman of CCITT Study Group XVIII, reported on the activities of his group, and presented his personal views on the present trend of the ISDN studies in the CCITT (Irmer, 1981a). The materials presented here, immediately following, are drawn largely from this address and from the Report of the meeting of Working Party XVIII/1 (CCITT, 1981-1984, S.G. XVIII No. R3).

Of the six concepts outlined as principles in G.705, the first three are presently subject to amendment. The first principle--that the dominant service (telephony) will determine the original ISDN parameters--was based on the belief the voice services would dominate the ISDN for years to come. The second principle--that 64 kbit/s should be the "integrating" standard bit rate in the ISDN to be respected by all the services--was a consequence of the first. The third principle--projecting the time frame of one or two decades--did not qualify the present equipment.

During the first plenary meeting of Study Group XVIII (Geneva, June-July 1981), these concepts were considered too limited. In particular, the bit rate of 64 kbit/s was considered both too high and too low:

1) for a full digital network like the ISDN, bit rates less than 64 kbit/s for voice services (e.g., 32 or 16 kbit/s) should not be excluded from the ISDN studies.

Table 15. Recommendation G.705 (Geneva, 1980) (CCITT, 1980, AP VII No. 103)

Integrated Services Digital Network (ISDN)
(Geneva, 1980)

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considering

the measure of agreement that has so far been reached in the studies of Integrated Digital Networks dedicated to specific services such as telephony, data and also of an Integrated Services Digital Network,

the need for a common basis for the future studies necessary for the evolution towards an ISDN,

the CCITT recommends that the ISDN should be based on the following conceptual principles:

1) The ISDN will be based on and evolve from the telephony IDN by progressively incorporating additional functions and network features including those of any other dedicated networks so as to provide for existing and new services.

2) New services introduced into the ISDN should be arranged to be compatible with 64 kbit/s switched digital connections.

3) The transition from the existing networks to a comprehensive ISDN may require a period of time extending over one or two decades.

4) During the transition period arrangements must be developed for the interworking of services on ISDNs and services on other networks.

5) The ISDN will contain intelligence for the purpose of providing service features, maintenance and network management functions. This intelligence may not be sufficient for some new services and may have to be supplemented by either additional intelligence within the network, or possibly compatible intelligence in the customer terminals.

6) A layered functional set of protocols appears desirable for the various access arrangements to the ISDN. Access from the customer to ISDN resources may vary depending upon the service required and on the status of evolution of national ISDNs.

Note: Existing relevant Recommendations for some of the constituent elements of the ISDN are contained in the G, O, Q and X series of CCITT and also in relevant volumes of CCIR.

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2) on the other hand, the rapid evolution of wideband services promoted by optical fibers could call for provision of bit rates of n X 64 kbit/s in the ISDN.

"Consequently, the role of telephony as the dominant voice service for determining the ISDN parameters is diminishing and non-voice services will have to be looked at more closely," Irmer stated.

Therefore, amendments were proposed for Recommendation G.705 by the plenary meeting of Study Group XVIII in July 1981 (CCITT, 1981-1984, S.G. XVIII No. R3). The first three principles of this Recommendation and the proposed amendments (underscored) are as follows:

1) The ISDN will be based on and evolve from the telephony IDN by progressively incorporating additional functions and network features including those of any other dedicated networks such as data packet switching so as to provide for existing and new services.

   The main feature of the ISDN is the support of voice and non-voice services in the same network. A key element of service integration for the ISDN is to provide a limited set of standard multipurpose user interface arrangements.

2) As far as practicable new services introduced into the ISDN should be arranged to be compatible with 64 kbit/s switched digital connections.

   The evolving ISDN may also include at later stages switched connections at bit rates higher and lower than 64 kbit/s. Switched connections include both circuit switched and packet switched connections and their concatenations.

3) The transition from the existing networks to a comprehensive ISDN may require a period of time extending over one or two decades. In the evolution towards the ISDN digital end-to-end connectivity may be obtained via plants and equipment used in existing networks, such as space division switching.

This new approach leads to a revision of the ISDN definition, Rec. G.702, given above in Section 5.3.2. The proposed definition summarizes the concepts found in G.705 and includes the enhancements suggested by Study Group XVIII:

> An ISDN is a network evolved from the telephone IDN that provides end-to-end digital connections to support a wide range of services, including voice and non-voice services, to which users have access by a limited set of standard multipurpose customer interfaces.

5.5.2 Proposed Framework of Studies

Question XVIII/1, "General network aspects of the ISDN," is considered urgent in all aspects. (The entire text of this question--without annexes--is reproduced as Appendix D. See CCITT, 1981-1984, S. G. XVIII No. 1, for a complete reference.)

The main considerations to be studied by Study Group XVIII in Question 1 are concerned with the overall studies related to the general features of future ISDN's capable of satisfying the requirements of many services. The Question has five points, each of which is under the direction of a special rapporteur. These points cover: service aspects, network aspects, customer access, interworking (between ISDN and service dedicated networks), and guidelines to facilitate evolution towards an ISDN.

According to Irmer (1981a), one of the main tasks is the possible definition of the type of customer access to the ISDN. The characterization of customer access types to the ISDN is being considered according to:

1) the types of information which may be transmitted via the access;
2) the information plan (characterized by bit rate, baud, etc.); and
3) the type of channels involved in the access.

It is hoped that Study Group XVIII will have agreed upon one unique access by the VIIIth P.A. in 1984.

The procedure to be followed in these studies, so as to arrive at the key Recommendations first, is critical. The July 1981 meeting propcsed that an initial list of points, to be covered by early Recommendations, include the following areas:

1) Systematic approach to service types and network features to support them;
2) Information types;
3) Channel types;
4) Access types;
5) Reference models for customer access configurations;
6) Reference models for network structures of the ISDN; and
7) Principles on interfaces.

It is recommended by Working Party XVIII/1, that priority should be given, initially at least, to that part of the ISDN which is based on and will evolve from the telephony IDN.

5.5.3 Resultant Changes in Operation of Study Group XVIII

The preceding material indicates that the structure of Study Group XVIII continues to evolve as the CCITT adapts to the accelerating pace of both telecommunication and computer technology, as well as to the increasing demands--worldwide--for new telecommunication services. These changes are not limited to structure, but exist also in modes of operation. CCITT Resolution No. 1 states that "Study Groups and Working Parties shall meet in principle once in the period of time between the end of a P.A. and ... the final meeting of the Study Group." (CCITT Orange Book I, page 197). This can be evaluated as hopelessly inadequate when measured by the following quote from Working Party XVIII/1. (Attention is drawn to the mention of the now accepted "annual" meetings, as another indication of the pace of change in the CCITT.)

> It became evident ... that areas, which up to the end of the last study period could only be treated in very broad and general terms, must and can now be studied very specifically and in detail (e.g., network aspects, service, customer access, etc.)
>
> It was recognized that in order to make the necessary and adequate progress in the studies of the ISDN for preparing the material for Recommendations and to establish guidelines for other study groups, it will be insufficient to adhere to the regular Study Group XVIII meetings on an annual basis. ... there is an urgent need for finding ways to expedite the work of ISDN, for example by arranging for additional ... meetings of Working Party XVIII/1 ... between the formal Study Group XVIII meetings (CCITT, 1981-1984, S.G. XVIII, No. R3).

5.6 Conclusion

The general framework, upon which the CCITT-promulgated Recommendations on the ISDN will take eventual form and substance, is seen to be dependent upon the work of Study Group XVIII. This work is moving ahead so quickly that continual attention to the work of this group is required by anyone seeking to keep abreast with ISDN studies in the CCITT. This section has provided an outline; only the CCITT documents themselves, at the present time, can fill in the details.

6. THE UNITED STATES ORGANIZATION FOR THE CCITT

The involvement of the United States in the work of the CCITT is channeled through the U.S. CCITT. This section discusses this national organization, summarizing its purpose, membership, structure, functions, and modes of communication with the International CCITT. Surveys of the growth of the international telecommunication market for the United States, and of the uniqueness of the U.S. telecommunication industry provide an introduction to this section. Section 7 considers the actual participation of the United States in CCITT activities.

6.1 Growth of Interest by the United States in CCITT Proceedings

The interest of the United States (RPOA's, private companies, industrial organizations, manufacturers, consultants, and even private individuals) in the activities of the International CCITT has been growing rapidly since the mid-seventies. As the international market has changed and continues to grow, in both the importing and exporting of telecommunication equipment and systems, knowledge of and participation in the development of the international Recommendations and standards has become increasingly important to the manufacturers of equipment as well as to the carriers responsible for the transmission of the information. The reasons for this relatively new, broad-based U.S. interest in the CCITT are the consequence of several domestic historical facts--such as: deregulation by the FCC, especially the Computer II decision; the new competition in the domestic telecommunication markets; and the digitization of the U.S. telephone network--as well as several worldwide changes. Two of these latter changes, which are considered here, are:

1) the rapid growth of international traffic, in and out of the United States, since the mid-sixties; and
2) the growth and complexity of U.S. involvement in the international trade of telecommunication (and related computer) equipment since the mid-seventies.

6.1.1 Growth of International Traffic

Before the mid-sixties, the volume of domestic communications within the United States greatly outweighed the rest of world communications outside the

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United States. Even more importantly, the ratio of the volume of U.S. international communication traffic to the volume of domestic traffic, in the order of a fraction of a percent, involved a small economic market. In contrast to this, the European situation (appropriate to this report since the origins of the CCITT were in Europe) presents a very different historical perspective. Because of the close geographical proximity of European countries, their international traffic always has been an appreciable percent of the total (10 to 20 percent) and is increasing all the time (de Haas, 1980). Consequently, Europeans have always worked to make their systems compatible with each other, which, in essence, has meant the establishment of international telecommunication standards.

For the United States, however, the external traffic--transatlantic or transpacific--besides being a very small percentage of the total traffic, was routed over very few points of entry (gateways). The necessary conversions at these gateways presented no appreciable difficulty. Furthermore, in the case of traffic to and from Canada, there is no gateway problem at all; Canada, in terms of communications, is integrated with the United States.

The above situation--small relative international traffic, and minimal gateway problems--did not necessitate extensive U.S. concern with the problems facing the CCITT. Requirements for standards within the United States were of much greater importance to the U.S. telecommunication community than questions concerning international standardization. Even so, the RPOA's providing the international service for the United States (AT&T and the International Record Carriers such as WUI and RCA) did interest themselves in the activities of the CCITT for decades past, although not always assuming the intensely active role of today.

The growth in international communications, which has contributed to the vital interest in the CCITT on the part of the United States, is indicated in Figure 3 (Dawidziuk and Preston, 1981). This figure shows the revenue earnings from overseas traffic in the United States from 1951 to 1978. This is shown for both the record carriers and the telephone industry. Figure 3 also reveals the following well-known phenomenon, which, in the long run has had its influence on the ISDN:

> Until good voice communications were established (pre-1956), revenues from record service well exceeded those from telephone service. With the improvement in quality of the telephone service, telephone traffic rapidly became the predominant revenue earner ...

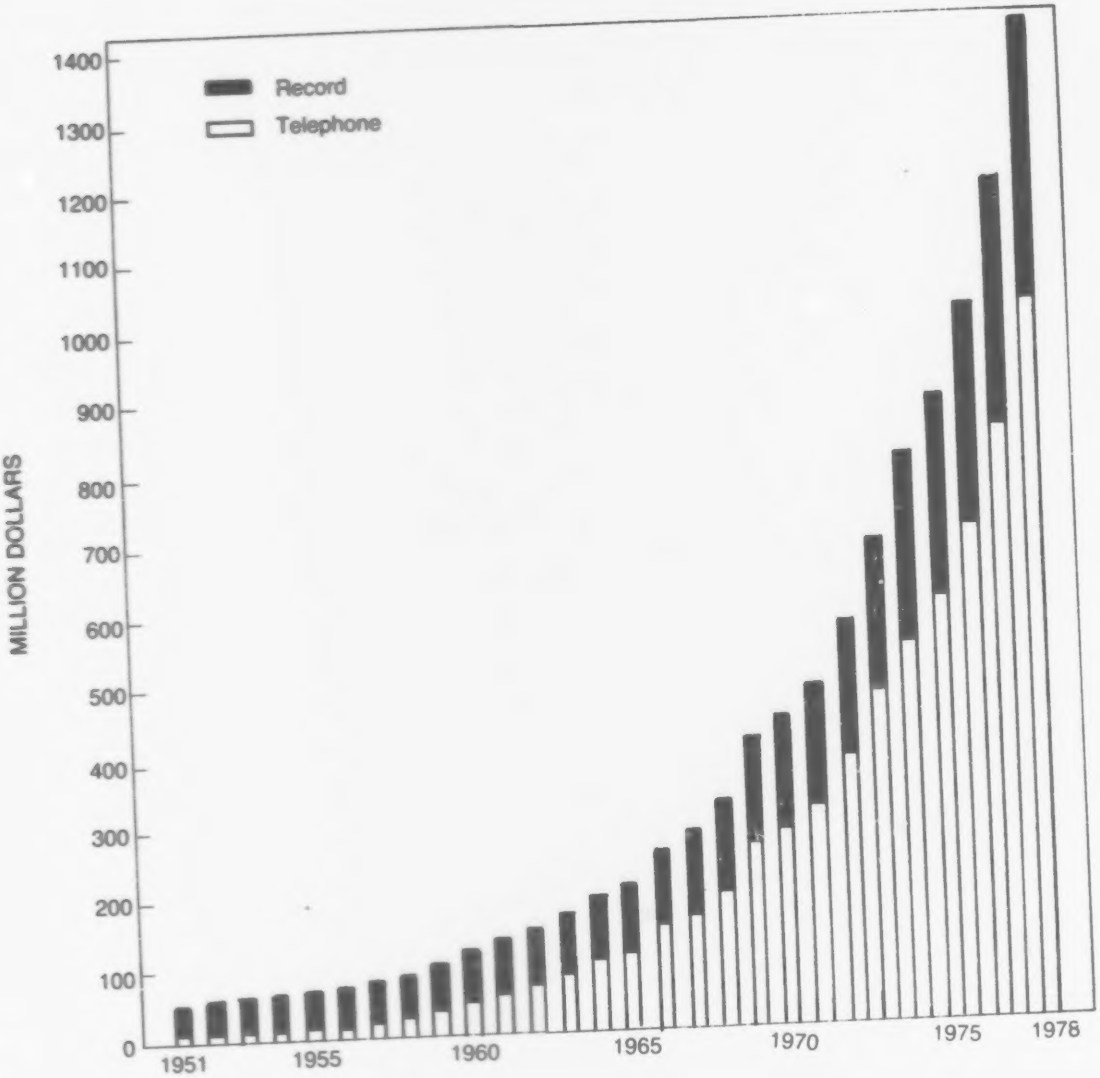

Figure 3. United States revenue from international services.

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> This type of behavior ... sets the pattern for dimensioning the international network in terms of circuit and bandwidth requirements (Dawidziuk and Preston, 1981).

Data on two time periods selected from this range (1951-1978), illustrate vividly the effects of new technology on the market. (Data are determined from Figure 3.)

1) 1956-1967 (1956: first transatlantic cable): The growth in revenues was 260%.
2) 1967-1978 (1965: commercial satellite facilities between United States and six European countries; 1970: fully automatic dialling): The growth in revenues was 700%.

In 1979 there were 140 million international calls in and out of the United States, representing an increase of 29 percent over that of 1978 (Hough, 1980). In 1980 there were 200 million international calls. Although still representing a fraction of one percent of total U.S. traffic —.09 percent--(there were about 220 billion calls in the United States in 1980), both the market and associated technology are growing appreciably.

6.1.2 International Trade

Prior to the mid-seventies, the U.S. telecommunication manufacturing industry, as well as the carriers, were somewhat indifferent to the telecommunication standards used in Europe, or in the rest of the world. Neither did the U.S. regulatory environment of the time encourage broad international trade in telecommunication equipment. In reality, the size, alone, of the domestic U.S. market justified a stong focus on U.S. standards. Furthermore, many experts contend that the European Administrations preferred to have standards which were somewhat different from those in the United States as a protection to their own markets. The fear was that, otherwise, the United States might swamp them with telecommunication exports. Actually, Western Electric, the chief supplier of telecommunication goods in the United States, had difficulty in just keeping up with Bell's requests; the rest of the U.S. telecommunication industry did not yet have extensive economic interest in overseas markets either. In addition, the United States had always had an overall positive balance of trade in its telecommunication market (mostly systems, not equipment).

However, all this has changed. By 1974 the United States telecommunications industry became concerned over the balance of international trade. This came at a time when:

> Telecommunications, which is now considered one of the major industries of the world, has assumed a great deal of importance to the governments, industry and the ultimate end user for a rapidly expanding role in our society. Especially in the U.S., where the dominant supplier for decades has had its role changed by a number of decisions through the varied regulatory agencies creating a new, indigenous manufacturing complex in telecommunication (Bazzy, 1976).

In response to the negative balance of trade in telecommunications, the U.S. Department of Commerce, Science and Technology Group, initiated a study which resulted in a report entitled: "Lowering Barriers to Telecommunication Growth" (Crombie, 1976).

The task force recommended that:

> 1) there be an acceleration of telecommunications to encourage full utilization of the technological developments now available in the United States;
> 2) regulating agencies take into consideration the long-term technical and economic impacts of their various decisions, and that data be made sufficiently available for a fuller understanding of these actions;
> 3) fuller use of existing U.S. technology be made to minimize the balance of payments currently afflicting the U.S. telecommunication industry and especially that sector involved in the consumer areas (Bazzy, 1976).

In turn, 56 telecommunication organizations, interviewed by members of the Department of Commerce task force, were encouraged to express their opinions on the reasons for the trade deficit. Several concerns were expressed, and among these the problems then associated with international standards received a good amount of attention. Relative to international standards, comments centered on the non-involvement of the United States in the ITU (especially CCITT), the dual-standards ("One for the United States, one for the rest of the world"), and the lack of a unified United States position on these issues, and on exporting in general. The following quote is a composite statement from four of the organizations, representative of those perceiving the above problems:

> Differing standards are a barrier to U.S. equipment ... making exporting less profitable. We should be involved in the development of basic standards. ... Only U.S. does not adhere closely to

> CCITT. [There is] more diversity within U.S. than in the rest of the world. [We need] more U.S. activity in CCITT. ... We have not had a unified, well-defined position. ... Most important--bring U.S. influence to bear to support U.S. specifications and standards in developing nations. ... The dual equipment standard provides no domestic sales base on which to capitalize on lower prices overseas (Hull and Cerni, 1976, unpublished OT/ITS document).

These problems, which emerged clearly in the mid-seventies, have continued to escalate; the solutions being applied to these problems include more effective participation by the United States in the CCITT.

6.2 Uniqueness of U.S. Telecommunication Structure

The position of public telecommunications (domestic and international) in the United States is unusual among the nations of the world, for we are one of a very few nations in which communications (excluding radio) are in the hands of the common carriers and other private industries and not under government control. Most communication systems in the free world operate through a quasi-government monopoly such as a PTT (Postal, Telephone and Telegraph Administration), and often these PTT's are able to represent their own national telecommunication industry's interest at CCITT meetings. For the United States, of course, it is very different. Although the interest of the U.S. government in public telecommunications is restricted largely to regulatory matters and matters of international trade, the government's position concerning the value of the CCITT to U.S. industry is clearly expressed by Richard Howarth, Chairman of the U.S. National Committee of the CCITT:

> Owing to the structure of the U.S. telecommunications industry, and the fact that the U.S. industry accounts for a large share of the investment and operations of the total world communication industry, the U.S. tends to rely more than other countries upon the participation of the private sector in CCITT activities. The U.S. Government finds this participation essential to the promotion of U.S. interests and to the evolution of an international telecommunications system facilitating the widest and fastest flow of information. (U.S. CCITT, Doc. No. 205)

Howarth further states the importance of the CCITT to international compatibility:

> ... we view the CCITT as providing an important interface between the foreign public and private U.S. communications sectors. Because it is important to promote the evolution of a compatible worldwide telecommunications system, the U.S. Government finds this interface more valuable than it would strictly bilateral negotiations betwen U.S. RPOA's and foreign governments.

6.3 Functioning of U.S. CCITT

The United States Organization of the CCITT, whose function it is to do preparatory work for the international meetings of the CCITT, is under the statutory jurisdiction of the Department of State. This is so because membership in the ITU is limited to national governments who, thereby, assume treaty responsibilities. Thus, the U.S. Organization of the CCITT and the official (and unofficial) delegations to the international CCITT meetings are always under the aegis of the State Department's Office of International Communications Policy, Bureau of Economic and Business Affairs.

6.3.1 Purpose of the U.S. CCITT

The U.S. CCITT Charter of 1977 offers the following purpose and definition of this organization:

> The purpose of the United States Organization for the International Telegraph and Telephone Consultative Committee is to assist and advise the Department of State on matters concerning United States participation in CCITT activities. The organization will:
>
> a) Promote the best interests of the United States in CCITT activities;
> b) Provide advice on matters of policy and positions in preparation for CCITT Plenary Assemblies and meetings of the international CCITT Study Groups;
> c) Provide advice on the disposition of proposed contributions (documents) to the international CCITT;
> d) Assist in the resolution of administrative/procedural problems pertaining to the United States CCITT activities (U.S. CCITT Charter).

6.3.2 Membership in the U.S. CCITT

Membership in the U.S. CCITT is encouraged to be broad based, so that delegates to the International CCITT have as clear a picture of the U.S. position(s) as possible. Presently, 57 U.S. companies are members of the CCITT (see Section 7.1); other U.S. telecommunication organizations do have a channel of indirect input to the proceedings of the CCITT by participation in the U.S. CCITT. Only those organizations with formal membership in the CCITT may send contributions to Geneva, however (see Section 6.3.4).

The criteria for membership in the U.S. CCITT are stated in the U.S. CCITT charter as follows:

> The criteria for membership on the National Committee and its Study Groups will be as set forth in the International Telecommunication Convention for participation in the CCITT, i.e., Government agencies, recognized private operating agencies, and scientific or industrial organizations which are engaged in the study of telecommunication problems or in the design or manufacture of equipment intended for telecommunication services. Each member will be expected to contribute constructively to the United States CCITT activities. (U.S. CCITT Charter)

The participants in the U.S. CCITT also include users' groups and national groups, such as the American National Standards Institute (ANSI) and the Electronic Industries Association (EIA). These participants in the U.S. CCITT enjoy a double benefit; they can keep abreast of the deliberations concerning the state-of-the-art technology in telecommunications, and they can provide their input to the contributions which go to the CCITT.

6.3.3 Structure of U.S. CCITT

The Charter defines the mechanism at work in the United States which provides the medium for getting information to the International CCITT. Figure 4 shows how this mechanism is structured in the United States. (Figures 4, 5, and 6 are adapted from de Haas, 1980). The U.S. CCITT structure does not parallel the study group structure of the CCITT itself.

The National Committee constitutes a steering body and has purview over the agenda and work of the four study groups and of the ISDN joint working

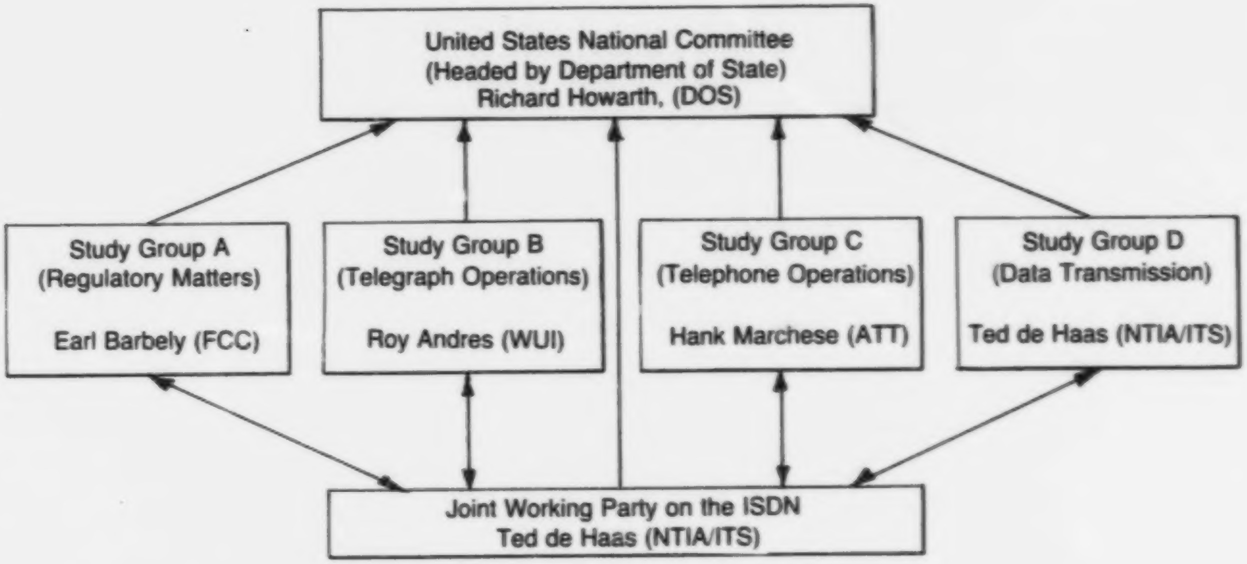

Figure 4. The structure of the U.S. CCITT and chairmen for 1981-1984.

party. Each of the four study groups, A to D, covers the work of several relevant international CCITT study groups. (e.g., Study Group D prepares contributions for CCITT Study Groups VII and XVII.) The Joint Working Party on the ISDN, recently established by the National Committee (May 1981), contains members of all four study groups in recognition of the probable impact of the ISDN on existing telegraph, telephone and data services, and will be concerned mainly with the contributions from the United States to Study Group XVIII pertaining to the ISDN. The Terms of Reference for this new group state:

> The primary function of the Joint Working Party will be: to review the contributions of other countries to Study Group XVIII and approve U.S. positions with respect to such contributions; and to approve U.S. contributions to Study Group XVIII. Inasmuch as various ISDN recommendations will be evolved by several other Study Groups, the Joint Working Party will maintain liaison with the appropriate U.S. Study Groups studying such recommendations. The liaison function will not derogate from the responsibilities of Study Groups A, B, C, and D to recommend positions and contributions for their respective international Study Groups. In the event of inconsistent recommendations from different U.S. Study Groups, the matter will be referred to the National Committee for resolution. (U.S. CCITT, Doc. No. 233)

Each of these groups meets at the discretion of its chairman. According to Part VIII of the U.S. CCITT Charter, the dates of each meeting, and proposed agenda, must be announced to the public both in the Federal Register and in a Department of State release at least 15 (working) days prior to the convening of a meeting. These meetings are open to the public and when "it is formally determined that it is in the public interest ... not to disclose National Committee or Study Group deliberations, the notices ... announcing the meeting will so state and omit the agenda."

6.3.4 Communication of U.S. CCITT with the CCITT

The contributions from the United States to the CCITT are not sent directly to Geneva from a member organization. Rather, the contribution is first passed through a formal chain of approval and/or coordination. The resultant approved contribution, depending on its source, may be either a "U.S." contribution or an "individual member" contribution; the U.S. contribution represents the position of a study group; the individual member contribution represents the position of one of the private organizations (presently 57) which are members of the CCITT. The vast majority of these individual contributions, past and present, have emanated from AT&T (see Section 7.2).

Figure 5 illustrates the chain of approval for a U.S. contribution. The chain starts with a presentation of a draft contribution to the relevant study group by a U.S. CCITT member or an ad hoc committee appointed by the study

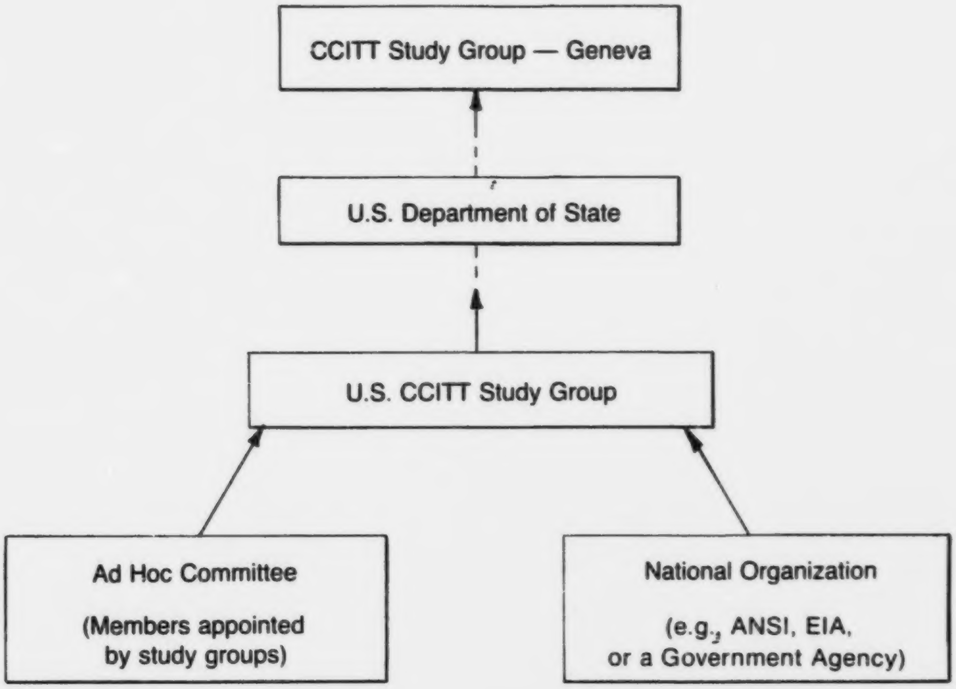
CCITT Study Group — Geneva
U.S. Department of State
U.S. CCITT Study Group
Ad Hoc Committee
(Members appointed by study groups)
National Organization
(e.g., ANSI, EIA, or a Government Agency)

Figure 5. Approval chain for "U.S." contributions to the CCITT.

group (e.g., the Modem Working Party (MWP) of U.S. CCITT Study Group D). The resultant discussion provides feedback to the contributor, and lends understanding and support (usually) to the position expressed by the formal contribution. Upon approval, the document is sent to Geneva via the Department of State.

Figure 6 illustrates the chain of approval for an individual contribution. This figure shows that the CCITT member organizations, although always encouraged to present their contributions to the relevant study group for discussion and feedback, are not obliged to do so under constraints of time (and other factors), but may work through the study group chairman, instead.

The purpose of this chain of approval, or system of coordination, is to avoid having highly controversial issues sent directly to Geneva from different quarters, which could lead to difficulties at the international CCITT

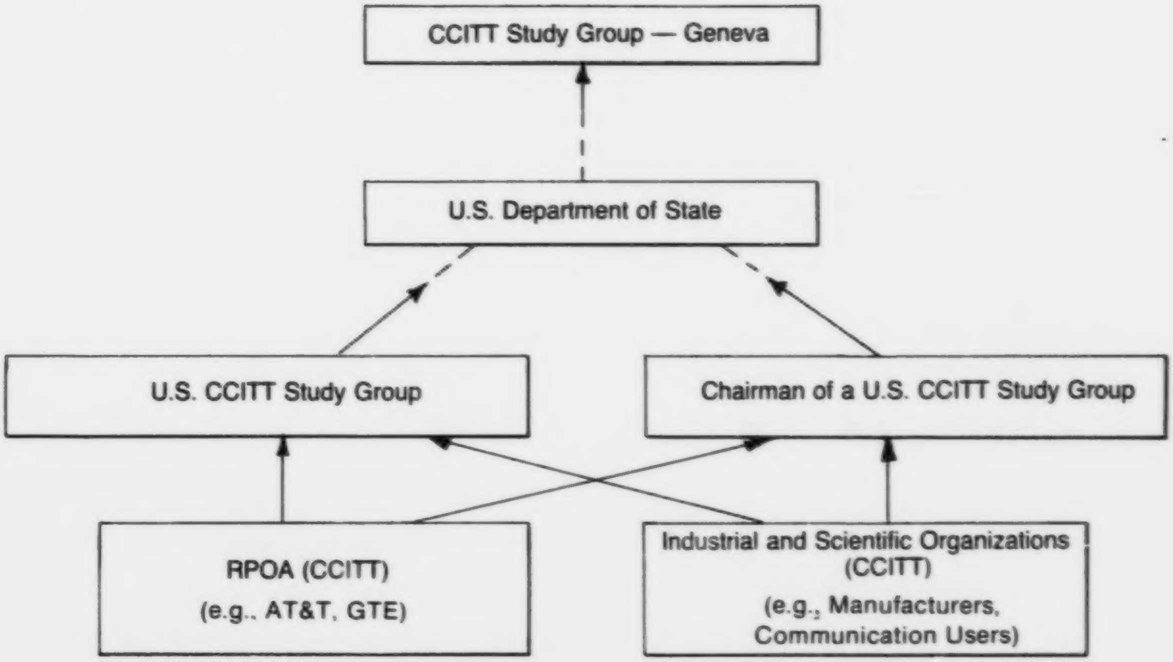
CCITT Study Group — Geneva
U.S. Department of State
U.S. CCITT Study Group
Chairman of a U.S. CCITT Study Group
RPOA (CCITT)
(e.g., AT&T, GTE)
Industrial and Scientific Organizations (CCITT)
(e.g., Manufacturers, Communication Users)

Figure 6. Approval chain for "individual member" contributions to the CCITT.

meetings. Different, and even opposing, positions might otherwise be championed by individual U.S. organizations and that could be detrimental to the United States as a whole.

As can be seen from Figures 5 and 6 above, the U.S. National Committee is not actually involved in these contribution proceedings at all; the National Committee is concerned only with matters of organization, responsibility, and patents. These contribution processes, outlined above, having very little government involvement, have worked quite well procedurally, and there is little incentive to change the existing structure at the present time.

The U.S. CCITT serves also as the pool of informed private sector personnel which can be drawn upon to staff U.S. delegations to the international CCITT study group meetings and to the plenary assemblies. The Department of State, in this case acting as the U.S. Administration, selects 10-12 delegates for each of the meetings to which an official delegation is to be sent. One person, appointed as head of the delegation, has comprehensive authority. "He is responsible for managing the work of his delegation and advancing the U.S. position at a meeting in the manner he judges to be most effective" (U.S. CCITT, Doc. No. 205). The authority of the head of the delegation also extends to any attendees from CCITT-affiliated firms who are not included in the formal delegation.

6.3.5 Summary of Main Functions of the U.S. CCITT

In summary, it can be said that the U.S. CCITT serves these four main functions:

1) it offers to the U.S. telecommunication industry, in general, a forum for participation in the standards-making process;
2) it serves as an arena for discussion and debate in its study group activity, preparatory to the development of U.S. positions and contribution agreement;
3) it provides, through this discussion and debate, guidance for delegates at the international meetings; and
4) it serves as a pool of informed and interested personnel from the private sector which can be drawn upon to staff the U.S. delegations to the international CCITT meetings; these delegates assist and advise the official U.S. delegate or the head of the delegation.

6.4 Conclusion

The changing international market for services and equipment, as suggested in this section, is a driving force for greater U.S. involvement in the CCITT. The structure of the U.S. CCITT is seen to be open enough for participation by any interested and involved telecommunication organization; thus, any concerned organization, CCITT member or not, can participate in some fashion in the CCITT Recommendation process. Section 7 indicates the extent of U.S. participation in the CCITT.

7. UNITED STATES PARTICIPATION IN THE CCITT

7.1 U.S. Membership in the CCITT

Presently there are 57 U.S. organizations--19 RPOA's (38 percent of CCITT total of 50) and 38 scientific or industrial organizations (28 percent of CCITT total of 136)--plus the U.S. government--each of which are dues-paying, official members of the International CCITT. Each organization has to have prior acceptance and sponsorship by the Department of State before becoming affiliated with the CCITT. Table 16 provides a list of these organizations (private telephone conversation, Richard Howarth, October 1, 1981).

7.2 Direct Participation of the United States in the CCITT

There are several modes of participation in the CCITT. These include attendance at meetings, submission of contributions, and extensive involvement through leadership roles. The data given below have been gleaned from relevant CCITT documents to give the reader some idea of the level of recent U.S. participation relative to that of other highly involved nations. Observations made and conclusions drawn from these data are presented in Section 7.3.

7.2.1 U.S. Participation in CCITT Study Groups, 1977-1980

During the 1977-1980 Study Period, an average of 30 nations participated in each of the 17 Study Groups, with a range of 23 (SG VI) to 40 (SG II). Of the 67 nations that took part in at least one study group activity, 15 nations participated in all 17. These 15 are:

1. Australia
2. Canada
3. China
4. France
5. Germany (FR)
6. Italy
7. Japan
8. Netherlands
9. Norway
10. Spain
11. Sweden
12. Switzerland
13. United Kingdom
14. United States
15. USSR

Table 16. U.S. Membership in the CCITT by RPOA's and by Scientific or Industrial Organizations (1981)

RPOA'S

1. Aeronautical Radio, Inc.
2. American Satellite Corp.
3. American Telephone and Telegraph Corp.
4. Communications Satellite Corp.
5. FTC Communications, Inc.
6. General Telephone and Electronics Corp.
7. Graphnet, Inc.
8. Hawaiian Telephone Co.
9. ITT World Communications, Inc.
10. MCI Communications Corp.
11. RCA Alaskan Communications, Inc.
12. RCA American Communications, Inc.
13. RCA Global Communications, Inc.
14. Satellite Business Systems
15. Telenet Communications Corp.
16. TRT Telecommunications Corp.
17. Tymeshare, Corp.
18. Western Union International, Inc.
19. Western Union Telegraph Co.

Scientific or Industrial Organizations

1. Antiope Videotex Systems, Inc.
2. Arthur D. Little, Inc.
3. Burroughs Corp.
4. Codex Corp.
5. Compass Communications Corp.
6. Control Data
7. Databit, Inc.
8. Extel Corp.
9. Exxon Enterprises
10. General Cable International, Inc.
11. General Datacomm Industries
12. General Electric Information Services
13. GTE International, Inc.
14. Harris Corp.
15. Hewlett-Packard
16. Honeywell, Inc.
17. Hughes Aircraft Co.
18. International Business Machines Corp.
19. International Telephone and Telegraph Corp.
20. Intertel, Inc.
21. MICOM Systems, Inc.*
22. Minnesota Mining and Mfg. Co.
23. Ormat Systems, Inc.
24. Paradyne Corp.
25. Planatronics, Inc.
26. Racal-Milgo, Inc.
27. Racal-Vladic, Inc.
28. Rapicon, Inc.
29. Raychem Corp.
30. Rixon, Inc.
31. Rockwell International Corp.
32. Stromberg-Carlson
33. Timeplex, Inc.
34. Tran Telecommunications, Inc.
35. Universal Data Systems, Inc.
36. United Telecommunications, Inc.
37. Wang Labs
38. Xerox Corp.

*Telecommunication Journal, October 1981.

7.2.2 Chairmen/Special Rapporteurs in Study Group XVIII, 1977-1980

During this same study period, there were 20 chairmen and special rapporteurs working in Study Group XVIII (Digital Networks). Figure 7 shows the distribution, by country, of these 20 leaders. The United States had four representatives in this group of 20, or 20 percent of the total.

7.2.3 Chairmen/Special Rapporteurs in Study Group XVIII, 1981-1984

The present study period has seen an increase in the number of leaders in Study Group XVIII from 20 to 28. These 6 chairmen and 22 special rapporteurs represent the same 11 countries indicated in Figure 7. The distribution for the 1981-1984 Study Period is shown in Figure 8.

7.2.4 Attendance at Study Group XVIII Meetings, 1977-1980

Study Group XVIII held four study group meetings in Geneva during the 1977-1980 Study Period. Data for the attendance of experts at two of those general meetings--October 1978, and May 1979--are shown below in Figure 9. All 21 nations represented at either or both of these meetings are included. However, the eight nations having 10 or more representatives accounted for 57 percent of the participation.

7.2.5 Attendance at the First Meeting of Study Group XVIII, 1981-1984

Figure 10 summarizes the data on the attendance at the Study Group XVIII meeting, held in Geneva during June-July 1981. The total attendance of 211 was more than twice that of either of the meetings depicted in Figure 9. Members from 24 nations participated, including 50 RPOA representatives and 78 scientific and industrial organization representatives. Table 17 lists the total participation, by country. The eight nations shown in Figure 10, each having at least 10 attendees, represented 65 percent of the total attendance.

The 32 participants from the United States represented: U.S. CCITT administrators (4); RPOA's: AT&T (14), Comsat (2), GTE (3), SBS (1), WUI (1); scientific or industrial organizations: Codex Corp. (1), Control Data Corp. (1), GTE International, Inc. (1), and ITT (4).

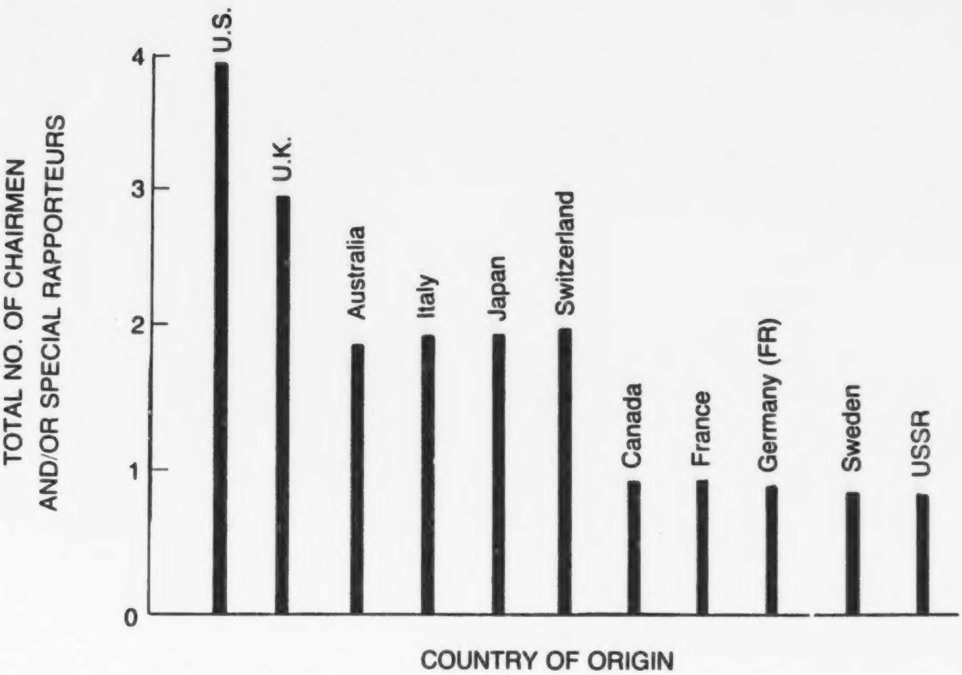

Figure 7. Distribution by country of origin of the 20 chairmen and special rapporteurs who participated in Study Group XVIII, 1977-1980.

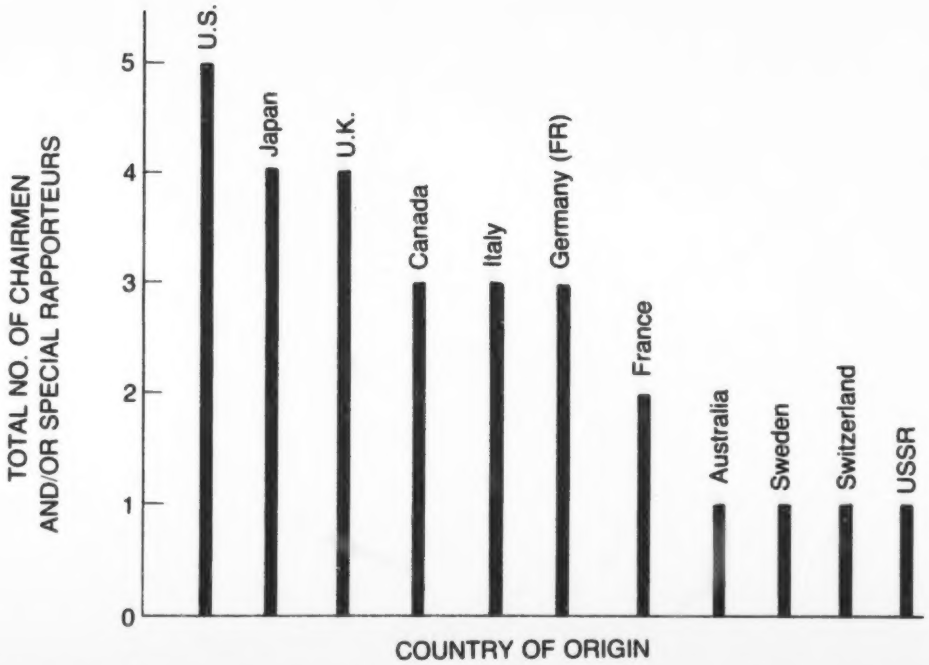

Figure 8. Distribution by country of origin of the 28 chairmen and special rapporteurs participating in Study Group XVIII, 1981-1984.

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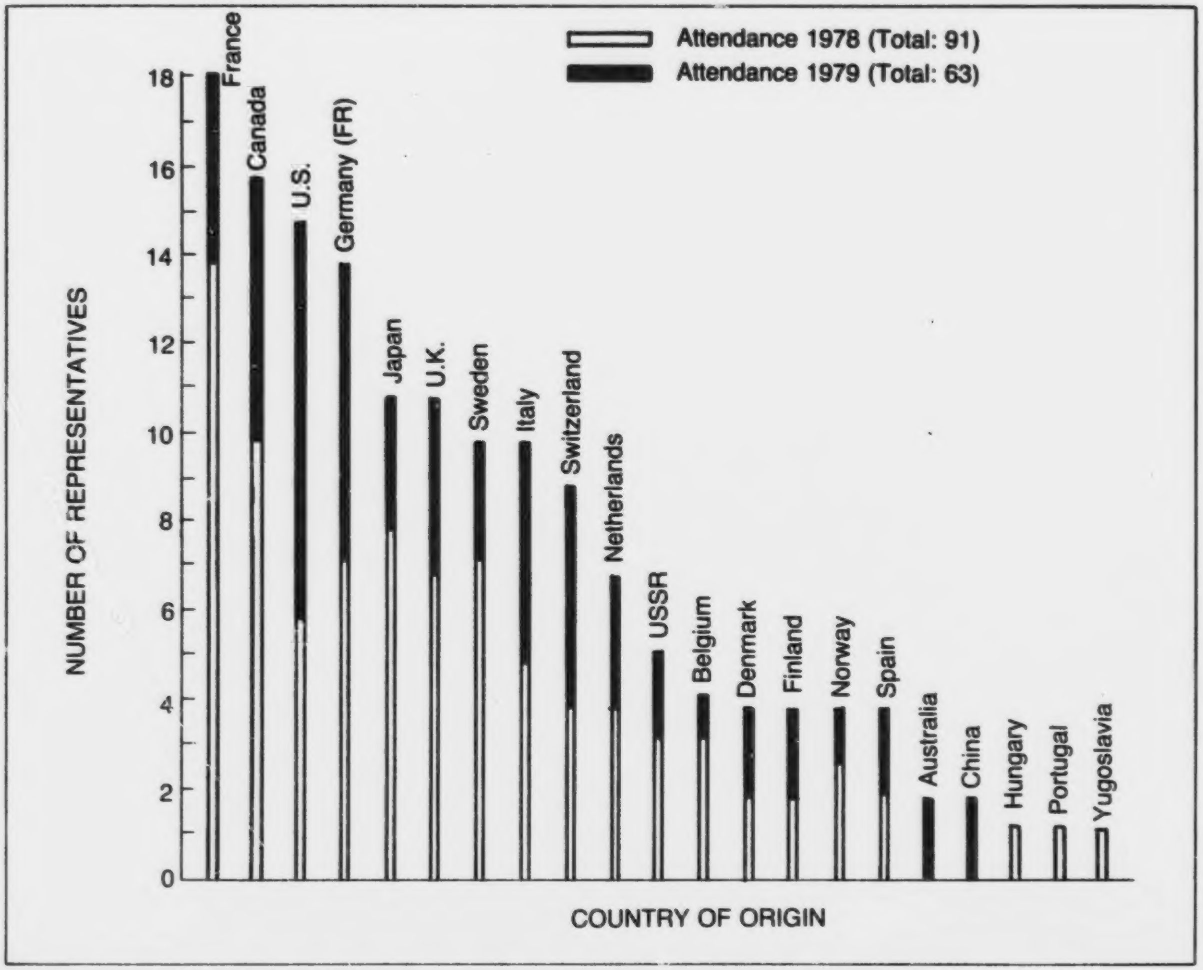

Figure 9. Attendance at two Study Group XVIII meetings during the 1977-1980 Study Period.

Table 17. Attendance at the Study Group XVIII Meeting, June-July 1981, Geneva

Nation	Number of Representatives		
	Administrative	RPOA	Scientific/Industrial
Algeria	3		
Australia	2	1	1
Austria	3		
Belgium	3		3
Brazil	2		
Canada	3	6	4
China	6		
Denmark	3		
Finland	1		2
France	8	1	21
Germany (FR)	3		12
Germany (DR)	1		
Hungary	2		
Indonesia	3		
Ireland	2		
Italy	2	4	2
Japan		10	4
Malaysia	3		
Netherlands	4		
New Zealand	1		
Norway	3		
Singapore	3		
Spain		2	1
Sweden	5		7
Switzerland	7		5
Tunisia	2		
United Kingdom		7	6
United States	4	21	7
USSR	3		
Yugoslavia	1		

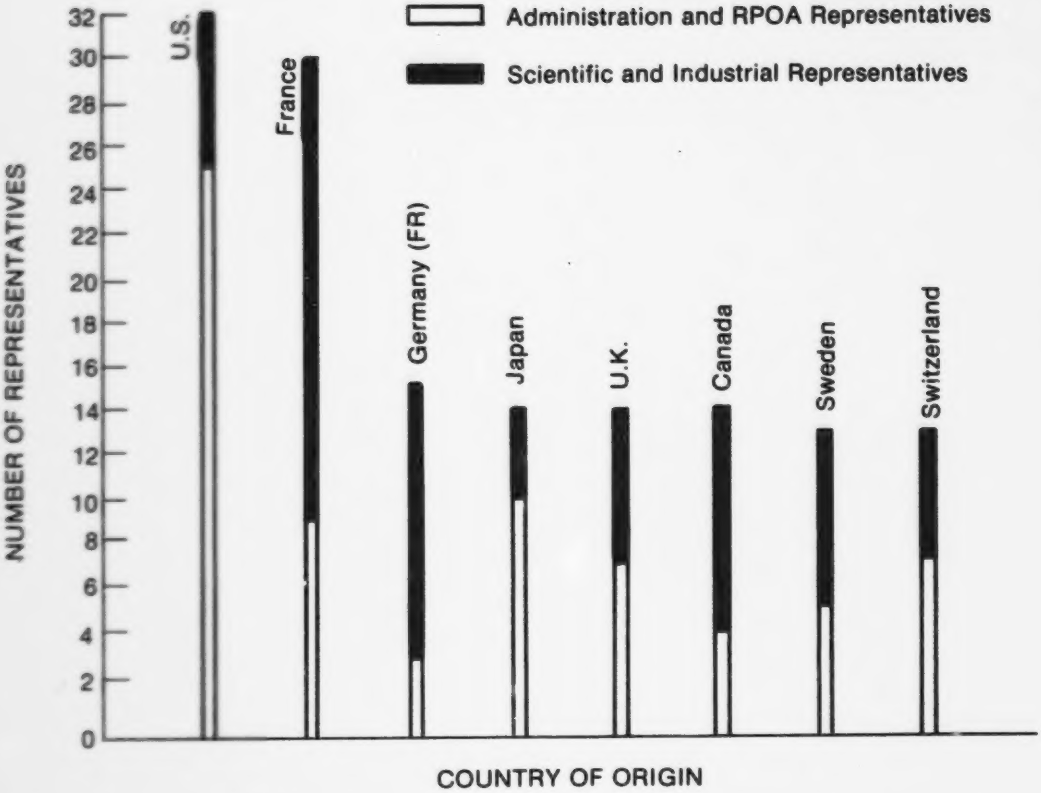

Figure 10. The eight nations having highest attendance at the first Study Group XVIII meeting during the 1981-1984 Study Period.

7.2.6 Attendance at the VIIth Plenary Assembly

The membership of the ITU in November 1980, was 153 nations, and of this number 85 had representatives in attendance at the VIIth P.A. of the CCITT in Geneva, November 1980. The number of delegates from these 85 nations was 515 (not including persons representing other international organization, etc.). Of these 85 nations, 8 had more than 10 attendees, with a total attendance of 195, i.e., attendance from these 8 countries constituted 38 percent of the total. Figure 11 shows the distribution of attendance for these eight nations.

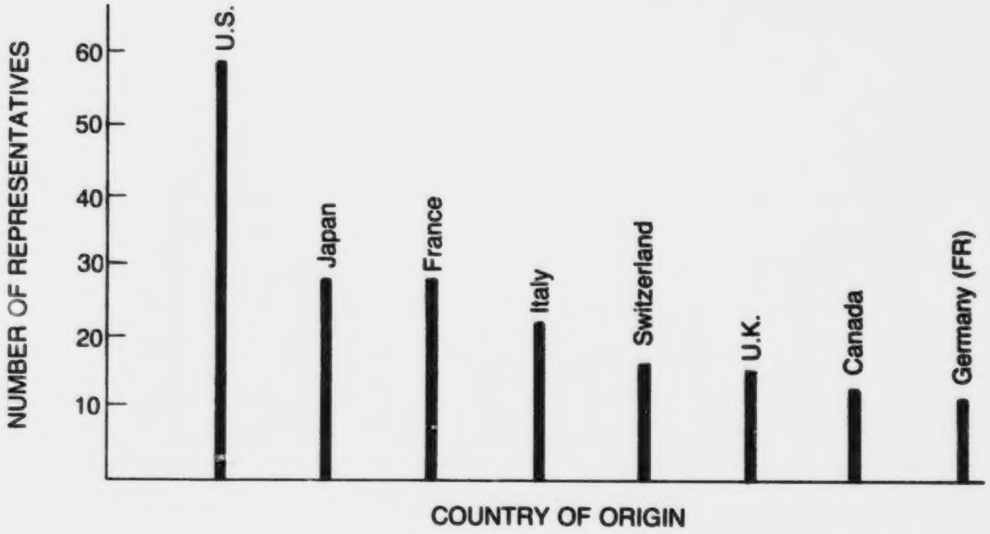

Figure 11. The eight nations having highest attendance at the VIIth Plenary Assembly of the CCITT, Geneva, November 1980.

7.2.7 Contributions from the United States to the CCITT Study Groups (December 1980 to November 1981)

The United States sent 63 contributions to CCITT study groups during 1981. The tabulation in Table 18 represents "white paper" contributions only, and includes only those received in the United States from Geneva during 1981. Although future documents will alter the data listed below, these numbers serve to show general trends.

7.2.8 Contributions to Study Group XVIII (December 1980 to April 1981)

The first 47 contributions to study Group XVIII in the present study period (1981-1984) have been tabulated, by source, in Figure 12. These contributions are dated from December 1980, to April 1981, in preparation for the first study group meeting which took place in Geneva, June-July 1981. Of the 13 contributions from the United States, 8 were from AT&T, 3 were from ITT, and 2 were from COMSAT.

Table 18. Contributions from the United States to the CCITT Study Groups (1981)

Study Group	Contributions U.S./Total	Percent U.S.	Source
I	3/35	9	U.S. (3)
II	10/43	23	AT&T (10)
III	0/1	0	----
IV	4/15	27	AT&T (4)
V	0/2	0	----
VI	0/13	0	----
VII	5/39	13	U.S. (5)
VIII	1/23	4	Comsat (1)
IX	0/23	0	----
XI	12/87	14	AT&T (8); ITT (4)
XII	0/21	0	----
XV	2/27	7	AT&T (1) Gen. Cable (1)
XVI	0/2	0	----
XVII	9/30	30	U.S. (6); ITT (1); AT&T (2)
XVIII	15/45	33	AT&T (9); ITT (3); Comsat (2)

During this meeting of Study Group XVIII, there were 45 delayed documents distributed to those in attendance; four were from the United States, all AT&T contributions. The number of these delayed documents has been added to the white paper contributions (from Figure 12), and the distribution tabulated again (Figure 13). Participation from Germany (at least in written form), as well as that of Japan and of Canada, is now seen to be sizeable. This tabulation (Figure 13) is done here to indicate the changing nature of any of the ongoing data presented in this section: these data, a snapshot of the present situation, are subject to rapid relative changes.

7.3 Observations/Conclusions

The data presented in Section 7 indicate, at the very least, current trends in CCITT participation by the United States. The following observations can be made from these data:

1) General participation by the United States in the work of the CCITT is prominent.

2) The United States is one of the 10 to 15 nations who are consistently involved, to a very high degree, in CCITT study group affairs. These

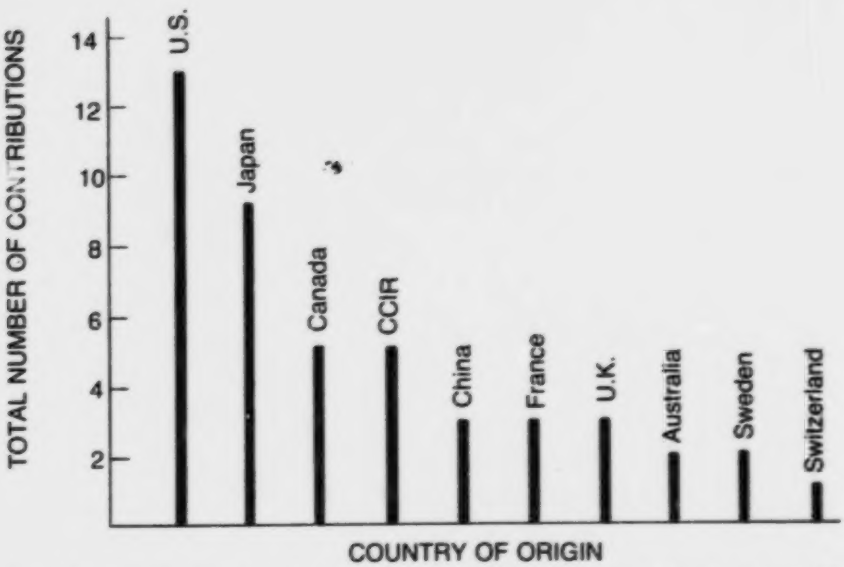

Figure 12. Distribution by country of origin of the first 47 contributions to Study Group XVIII during the 1981-1984 Study Period.

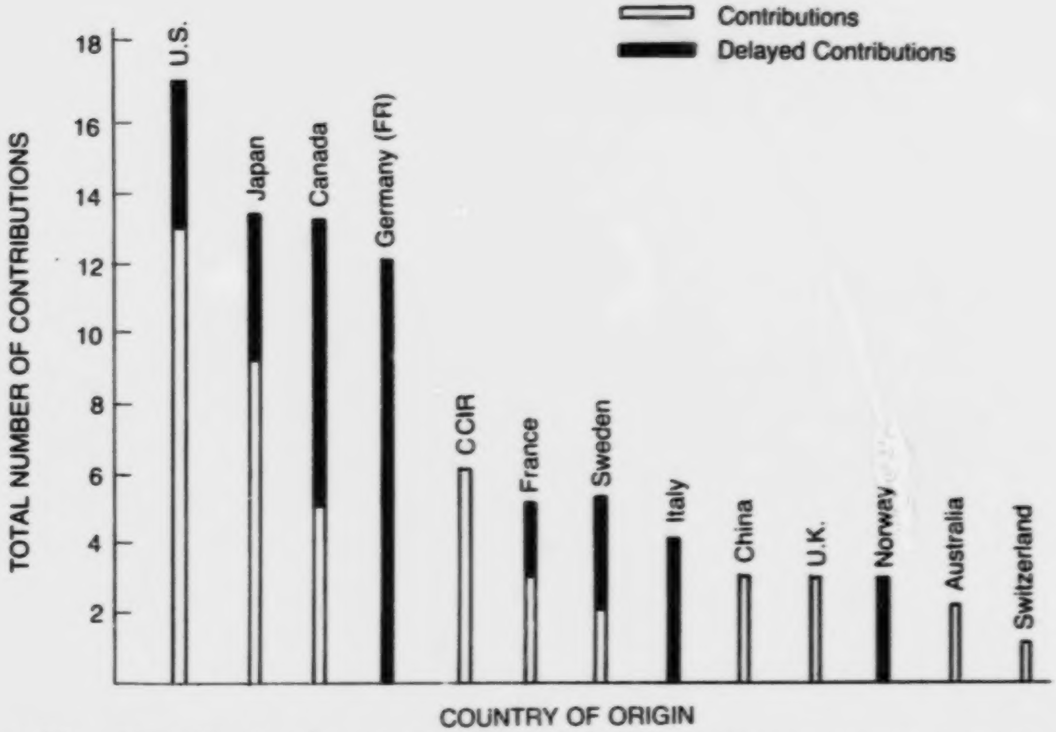

Figure 13. Distribution by country of origin of the first 47 contributions plus the 45 delayed documents of Study Group XVIII considered at the meeting held in Geneva, June-July 1981.

nations correspond to the list presented in subsection 7.1, with the possible exceptions of China and the USSR.

3) Contributions from the United States to the study groups are relatively numerous in the related areas of the ISDN, telephone operations and maintenance, telephone switching and signalling, data networks, and transmission of data over telephone networks (Table 18). Fifteen percent of the CCITT contributions (administrative or individual member) that were distributed worldwide by Geneva during 1981 were from the United States (61/406).

4) U.S. attendance at CCITT meetings is pronounced. At the VIIth P.A. (Figure 11), the U.S. representation was 11 percent of the total attendance (85 nations represented). The United States, with an attendance of 58, had more than twice as many representatives as did the countries with the next highest attendance--Japan and France, with 28 each. The U.S. attendance at the Study Group XVIII meeting in June-July 1981 (Figure 10), was 15 percent of the total (32/211).

From these above observations, it is reasonable to conclude that the CCITT studies and standards-making programs are important to an active segment of the U.S. telecommunication industry. Interest in the rapid development of worldwide standards as an encouragement to telecommunication growth is evidenced by the above data, especially in the work of Study Group XVIII and other related ISDN studies.

Mr. Ted de Haas, chairman of the U.S. CCITT Joint Working Party on the ISDN, summarized recent discussions of this group in this way:

> ... European administrations, in particular, want a set of standards in the ISDN in this plenary period; if this cannot be accomplished in the CCITT framework they will likely go ahead anyway, for example, in CEPT. Even though the U.S. faces certain problems with the ISDN, which are peculiar to the U.S. environment, it was felt that the U.S. should participate to the maximum extent in the CCITT work in order to avoid dual standards in the future (U.S. CCITT, No. HC 241).

This quote serves to summarize this section, as well.

8. SUMMARY

Figure 14 illustrates the general approach taken in this report: the CCITT is seen to function as both a converging lens (1965-1980) and a diverging lens (1981-?). The CCITT studies and Recommendations of the past two decades have effectively converged to a focussed concept of the telephony-based ISDN; this ultimate direction was not always clearly envisioned. However, it is to this focal point, the ISDN, that the major attention of the CCITT is now drawn. As a result, the work of the present decade--and beyond--will involve, to a large extent, the development of the myriad possibilities within this concept, and will attempt to provide the Recommendations upon which the ISDN-related international telecommunication standards can be based.

The CCITT, of course, is not the only standards-making group studying the ISDN. Notable among other groups is the European Conference of Posts and Telecommunication Administrations (CEPT) which is enthusiastically pursuing studies on this topic. "Although a world rather than a regional standard is to be preferred, CEPT ... is not bound by the same constraints as the CCITT and has been able to evolve a structure optimised to the production of rapid results" (Wedlake, 1981). Reports, parallel to this current one, could surely be written on any such organization.

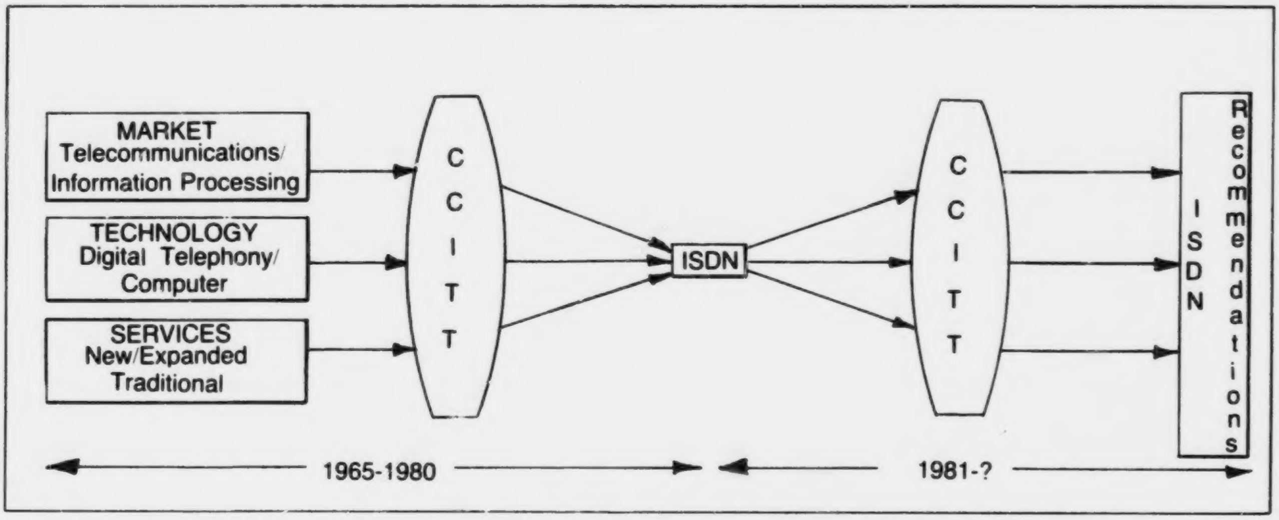

Figure 14. The focussing of the ISDN concept and the development of its operational details.

Although it is less than a decade since the CCITT first seriously considered this topic, the opinion of many experts (though not all) is that the international net of the ISDN will be solidly in place by the year 2000, and functionally in place by 1990. By 1985, model networks are expected to be in operation in several countries. Because the ISDN is customer oriented and increasingly market driven--business, home, public service--the value of the future integrated network will be in direct proportion to the ease of customer access to it.

The United States telecommunication industry is showing great interest in the development of both the ISDN and the U.S. CCITT, especially through its ISDN Working Party, and gives promise of making sizeable contributions to the enormous international effort toward integration. The developments in Study Group XVIII, outlined in Section 5, are indicative of the dynamism attending the present international studies.

The chairman of the 1981 International Switching Symposium, Mr. Charles Terrault, touched upon the basic need for an integrated network such as the ISDN:

> We probably are among the best qualified to bear witness to the enormous amount of information that is assailing us from all sides. We are in the middle of it. The disorder in which we receive it and the difficult task of finding one's way in it probably are some of the main reasons for its geometric growth.
>
> Only if we order what is disordered, only if we create research algorithms which are both powerful and simple, will telematics and videotex fulfill their promises (Myers and Raggett, 1981).

And these promises--ultimately summed up in a concept such as an ISDN--are envisioned as coming to fulfillment, by ITU Secretary-General, Mili. His statement, below, brings this report to full circle:

> We are on the threshold of a new era in which electronics will reign supreme. The traditional concept of the telecommunication network will have to give way to that of an integrated network

> permitting the circulation of many kinds of information ... the ITU and its 155 member countries have high responsibilities connected with promoting the harmonious development of international telecommunications. Since progress ought to benefit the whole of mankind, the aim must be to promote understanding and dialog among all human beings wherever they may be, so that telecommunications remain what they have always been, a factor of harmony and peace. This gives us an inkling of the dimensions of the challenge (Anderson, 1981).

9. ACKNOWLEDGMENTS

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APPENDIX A: STATEMENT BY THE ISO COUNCIL

International Telegraph and Telephone
Consultative Committee
(CCITT)

COM VII-No. 28E

Period 1981-1984

Original: English/French

Date: January 1981

STUDY GROUP VII - CONTRIBUTION NO. 28

SOURCE: DIRECTOR OF THE CCITT

TITLE: STATEMENT BY THE ISO COUNCIL

The ISO Central Secretariat informed us recently by an ISO statement of their position concerning development of international standards in the area of information systems (see Annex).

Comments are invited with a view to formulating a CCITT interpretation of this statement in the area covered by Study Group VII.

Annex: 1

ANNEX

ANNEX TO CIRCULAR LETTER
ISO/TC 95/TC 97 1980-12-18

ISO position concerning development of international standards in the area of information systems

Statement by the ISO Council

The increasing scope of application of information systems and the broadening use of its basic techniques and technology in other fields such as communication, have created questions of jurisdiction in the international standards community. This has an effect on the ISO technical work, and ISO has therefore examined the matter with a veiw to stating its own positions concerning development of standards in the area of information systems. The position of ISO is the following:

1. The ISO process encourages the broadest participation by all concerned parties in the development of ISO International Standards. It allows for active participation from other international organizations and standardizing bodies which have interest in the relevant ISO standards programmes and it provides a mechanism for integrating the work of national and international committees into an international standards development process, which has working within it most of the leading technical experts in the respective fields of technology. This applies very much to the area ot information systems.

2. In the area of information systems, ISO has established a comprehensive standards framework for incorporating the complex interrelationship between elements of information processing and telecommunications through the development of the Open Systems Interconnection (OSI) model.

3. ISO is of the opinion that the primary international organization responsible for development of standards in the area of information systems has been ISO. This situation has developed and should continue, consequent to the fundamental and very important factors mentioned above.

4. By their scopes ISO TC 95 - Office machines and TC 97 - Computers and information processing are responsible for establishing international standards in the area of information systems.

5. ISO is however committed to maintaining a spirit of close cooperation with other international organizations in the development of international standards in order to enhance cooperation and understanding, properly reflect user needs, avoid duplication of effort in standards development, avoid the development of conflicting standards and insure timely and orderly development of relevant standards.

6. In conformity with ISO policy, ISO/TC 95 and TC 97 are also committed to maintaining an international standards development process which will allow active participation by all concerned parties.

7. ISO is responsible for the definition, interpretation and further development of the global OSI reference model in cooperation with other international organizations. In this context ISO considers:

7.1 That ISO has primary responsibility for the development of international standards for use with office machines and data systems where those standards relate to the Application Layer, Presentation Layer, Session Layer and Transport Layer as set forth in the ISO Reference Model on Open System Interconnection. This includes information exchanges in the form of digitalized image, text and formatted data.

7.2 That in regard to the Physical Layer, Data Link Layer and Network Layer, ISO has primary responsibility for the development of international standards for the transfer of information between office machines and data systems by non-public telecommunications means and by the transfer of physical media.

8. It is noted that ISO-TC 95 and TC 97 are setting up a special group to study all aspects of their standards development work with the objective of recommending within six months, and in consultation with their sub-committee chairmen and working group convenors, further improvements in the standards process and increasing its responsiveness.

9. It is also noted that the Secretary-General of ISO continually maintains contacts with officials of all other interested international organizations to discuss and develop a framework for greater cooperation in the area of information systems based on the principles mentioned above.

APPENDIX B: PROPOSED REVISION OF RECOMMENDATION A.20

International Telegraph and Telephone
Consultative Committee
(CCITT)

COM VII-No. 27E

Period 1981-1984

Original: English

Date: January 1981

STUDY GROUP VII - CONTRIBUTION NO. 27

SOURCE: ISO/TC 95 AND TC 97 (MADRID, NOVEMBER 1979)

TITLE: PROPOSED REVISION OF CCITT RECOMMENDATION A.20 (DOCUMENT TC95 N418/TC97 N834)

RECOMMENDATION A.20
(revised)

COLLABORATION WITH OTHER INTERNATIONAL ORGANIZATIONS OVER DATA TRANSMISSION
(Geneva, 1964; revised at Mar del Plata, 1968, and at Geneva, 1972 and 1976)

The CCITT,

considering

that, according to Article 1 of the agreement between the United Nations and the International Telecommunication Union, the United Nations recognizes the International Telecommunication Union as the specialized agency responsible for taking such actions as may be appropriate under its basic instrument for the accomplishment of the purposes set forth therein;

that Article 4 of the International Telecommunication Convention (Malaga-Torremolinos, 1973) states that the purposes of the Union are:

a) to maintain and extend international cooperation for the improvement and rational use of telecommunication of all kinds;
b) to promote the development of technical facilities and their most efficient operation with a view to improving the efficiency of telecommunication services, increasing their usefulness and making them, as far as possible, generally available to the public;
c) to harmonize the actions of nations in the attainment of those ends;

that Article 40 of the Convention states that, in furtherance of complete international cooperation on matters affecting telecommunication, the Union shall cooperate with international organizations having related interests and activities;

that in the study of data transmission the CCITT has to collaborate with the organization dealing with data processing and office equipment* and particularly the International Organization for Standarization (ISO) and the International Electrotechnical Commission (IEC);

that this collaboration has to be organized in a manner which will avoid duplication of work and decisions that would be contrary to the principles set out above,

unanimously declares the view

that the international standards for data transmission should be established with the following considerations in mind:

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*)Approved by the VIIth CCITT Plenary Assembly, November 1980.

1. Clearly, it will be the responsibility of the CCITT to lay down standards for transmission channels, i.e., aspects of data transmission which require a knowledge of telecommunication networks or affect performance of these networks.

2. The standardization of signal conversion terminal equipment (modems) is the province of the CCITT, the standardization of the junction (interface) between modem and the data terminal equipment is a matter for agreement between CCITT and the ISO or the IEC.

3. Devices designed to detect and/or correct errors must take account of:
- the error rate tolerable to the user;
- the line transmission conditions;
- the code, which has to meet the exigencies of the data alphabet and the requirements of error control (this must be such as to give an output satisfactory to the user) together with the requisite signalling (synchronizm, repetition, signals, etc.).

Standardization here may not come wholly within the CCITT's province, but the CCITT has very considerable interests at stake.

4. The alphabet (Definition 52.02 in the List of Definitions) is a "table of correspondence between an agreed set of characters and the signals which represent them."

The CCITT and the ISO reached agreement on an alphabet for general (but not exclusive) use for data and message transmission and have standardized a common alphabet which is known as International Alphabet No. 5 (CCITT Recommendation V.3) (ISO 646-1973: Seven-bit coded character sets for information processing interchange).

Further complementary study of some control characters and graphics of the alphabet should be effected in cooperation with each other.

5. Coding (Definition 52.05 in the List of Definitions) is "a system of rules and conventions according to which the telegraph signals forming a message or the data signals forming a block should be formed, transmitted, received and processed." Hence, it consists of a transformation of the format of the

signals in the alphabet for taking account of synchronous methods and introduction of redundancy in accordnace with the error-control system. This is not a field in which the CCITT alone may be able to decide; however, no decision should be taken without reference to the Committee because of the possible restrictions which transmission and switching peculiarities may impose on coding.

When the general switched network is used (telephone or telex) and when the error control devices are subject to restrictions (switching signals - reserved sequences), it is the CCITT which is in fact responsible for any necessary standardization in conjunction with other bodies.

6. The limits to be observed for transmission performance on the transmission path (modem included) fall within the competence of the CCITT; the limits for the transmission performance of the sending equipment and the margin of terminal data equipment (depending on the terminal apparatus and the transmission path limits) should be fixed by agreement between the ISO and the CCITT.

7. In all instances, the CCITT alone can lay down manual and automatic operating procedures for the setting-up, holding, and clearing of calls for data communications when the general switched networks are used, including type and form of signals to be interchanged at the interface between data-terminal equipment and data circuit-terminating equipment.

8. When a public data network is involved, the CCITT has the responsibility to provide the Recommendations which apply, taking into acocunt relevant ISO work. When CCITT or ISO is developing or changing standards that may impact the design and features of data processing systems (normally DTE) and office equipment,* and which may affect compatibility between public data networks and DTE's, these should be based on cooperation between them.

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*)Approved by the VIIth CCITT Plenary Assembly, November 1980.

Note by the CCITT Secretariat: "Paragraph 8 as approved by the VIIth Plenary Assembly is the following:

"8. When a public data network is involved, the CCITT has the responsibility to provide the Recommendations which apply. Where these Recommendations have an impact on the basic design and features of data processing systems and office equipment (nominally DTE), they shall be the subject of consultation between CCITT and ISO and in some cases a mutual agreement may be desirable. Likewise when the ISO is developing or changing standards that may affect compatibility with the public data network there shall be consultation with the CCITT."

APPENDIX C: THE ISDN FROM THE USER'S PERSPECTIVE

International Telegraph and Telephone
Consultative Committee
(CCITT)

COMM. XVIII-No. XX

Period 1981-1984

Original: English

Question 1, 2/XVIII

Date: January 1982

STUDY GROUP XVIII - CONTRIBUTION NO. XX

SOURCE: American Telephone and Telegraph Company

TITLE: The ISDN From the User's Perspective

I. Introduction

The ISDN can be viewed from the user's perspective and from the network perspective. This contribution identifies the importance of considering the user's perspective of the ISDN.

II. The Importance of the User' Perspective

1. The ISDN is a new concept in telecommunications. From the user's perspective, telecommunications networks and services must be considered in setting standards for the ISDN.

2. Much of the success of telephone networks is because of their uniformity. Uniformity was achievable because of the homogeneity of human speech which telephony networks are designed to serve.

3. The ISDN is being designed to serve a wide variety of applications ranging from low speed telemetry, interactive data, voice, facsimile, high speed data, and even video. Given this wide spectrum of applications, standards play an important role in assuring the success of the ISDN.

4. The cost to the user of information communications and handling is a primary factor from the user's perspective. The uniformity of the interface is also important. The characteristics of the small family of interfaces which affect the user's perspective, and which should be standardized include: the mechanical, physical, electrical, and functional aspects of ISDN user interface; the logical and protocol characteristics across the interface; the characteristics of the services which will be offered at the interface by the ISDN, including the messages to signal, activate and control the services; and the performance characteristics associated with these services as provided by the ISDN.

III. General Objectives for the ISDN from the User's Perspective

1. The ISDN should provide the user with competitive price performance.

2. The ISDN should appear uniform to users over a wide range of applications.

3. The ISDN should provide a consistent set of procedures for accessing similar capabilities even though different services are used.

4. A small family of multipurpose interfaces should be provided, each covering a wide range of applications.

5. There should be a common structure for these different multipurpose interfaces, including information channels and signalling channels.

6. The same protocols should be used to perform similar functions, for a given class of terminal equipment even though different interfaces are used.

7. A choice of performance or service grades should be available for all services and interfaces to allow the user to exercise economic trade-offs.

8. Maintenance and related procedures and messages should be standardized for all applications (although not all options need be available in every application).

9. Features should be structured in an upward compatible nested structure so that simple terminals can use the simpler aspects of sophisticated capabilities and vice versa.

10. The ISDN should provide graceful evolution for terminals to migrate from today's networks including PDN and GSTN, to the ISDN. Unnecessary obsolescence is to be avoided.

APPENDIX D: QUESTION 1, STUDY GROUP XVIII, 1981-1984

Question 1/XVIII - General network aspects of an Integrated Services Digital Network (ISDN) (continuation of part of Question 1/XVIII, studied in 1977-1980)

This questions is concerned with overall studies related to the general features of future Integrated Services Digital Networks capable of satisfying the requirements of many different services. Study Group XVIII will define the scope and framework of an ISDN and identify the services which may be incorporated in such networks. It will study the evolution of Integrated Digital Networks (IDN's) dedicated to specific services (e.g., telephony, data) towards an ISDN.

The objectives will be to define overall network and system principles which can form a basis for study and Recommendations by appropriate specialist CCITT Study Groups. The generic features appropriate and applicable to an ISDN will be identified together with optional service dependent features applicable to part of an ISDN.

The study of the following five related aspects will take into account the considerata arising from studies carried out during the 1977-1980 study period as recorded in Annex A to this Question. In addition, the multiple aspects of this work require coordination between the various Study groups involved (e.g., Study Groups III, VII, XI, XV, XVI, XVII and XVIII).

Some of these Questions have to be studied initially by Study Group XVIII, with high priority, to enable other Study Groups to initiate or continue their work and to draft Recommendations within the current CCITT study period. In other cases Study Group XVIII needs information from other Study Groups in order to make progress in its own network studies.

Recommendation No. G.705 provides information and future developments of the ISDN.

Studies of ISDN aspects were carried out under Questions 1/XVIII during the 1977-1980 study period and a partial reply to that Question is reproduced as Annex 1 to this new Question. Annex 2 records many points already identified and of relevance to the ongoing studies. Annexes 3 and 4 contain significant information which was not fully considered before the end of the study period. These Annexes are also of relevance to other new Questions of Study Group XVIII.

Note: The Chairmen and Vice-Chairmen of the Study Groups involved (Study Groups III, VII, XI, XV, XVI, XVII and XVIII) will jointly assess the progress made by the various Study Groups and initiate any steps necessary to expedite the work. This should take place at about the middle of the study period (e.g., beginning of 1982), with the Chairman of Study Group XVIII acting as convenor for this coordination.

Considering

a) that the requirements of data transmission services and several new non-voice services are being studied by CCITT.

Note: In several countries services dedicated digital networks are already in service or will be installed for non-voice services that may use part of the ISDN for access to this network.

b) many countries wish to adopt a common strategy for extending the use of Integrated Digital Networks (IDN) beyond the telephony application to form Integrated Services Digital Networks,

c) telephony service will constitute the major portion of the carried load on digital networks characterized by time division transmission and switching and common-channel signalling,

d) efficiency and economy of methods of access to the ISDN from customer terminals are significant factors in planning the local network,

e) CCITT Recommendations on digital switching and inter-exchange signalling, which take into account the future evolution of the IDN for telephony towards the ISDN, are already available in the Q series and may form the basis for future Recommendations on ISDN.

Point A. Service aspects

1. Which services should be taken into account in the establishment of network features of the ISDN?

2. What are the network features needed to support these services? Which network features should be regarded as general throughout the ISDN, and which should be classed as service dependent for particular service applications?

Note: Among other network features, attention should be paid to charging so that adequate information could be made avilable for charging purposes.

3. For which services, if any, should a change of service on an established connection be envisaged? What are the implications and requirements of such a feature?

4. What kinds of leased paths will be required in the ISDN when it is in widespread operation?

Note 1: Services should be identified which will supplant existing leased line services.

Note 2: Consideration should be given to the use of semi-permanent connections, closed user group and hot-line features, remote switching units etc.

Point B. Network aspects

1. What are the principles in terms of network structure and systems architecture which define the ISDN and which form the basis for study of specific aspects?

2. Should layered protocols and functional layers be adopted for ISDN to form the basis of CCITT Recommendations? If so, what are the characteristics of this layering, and in which way is the concept of functional layers used with respect to sub-systems, such as, e.g., the signalling channels?

3. What are the implications of ISDN on numbering plans and service indicators for telephony and other services?

4. What methods of voice band encoding other than standard PCM (see also Question 7/XVIII) and what forms of digital speech interpolation can be considered in relation to the evolution of the ISDN?

Point C. Customer access

What are the principles in terms of network structure and systems architecture which define customer access to ISDN and which should form the basis of studies of related transmission, switching, signalling and interface aspects?

Point D. Interworking

What are the principles which should form the basis for detailed study of the interfaces interconnections and interworking between ISDN and service dedicated networks?

The following specific points should be included in the studies:

i) At what point in the connection should special processing for interworking be accomplished (e.g., in the originating or terminating country)?
ii) What networks should be given preference to complete connections in a transit call situation?
iii) What special problems arise from the use of ISDN to provide interconnections of particular services (e.g., according to X.21, etc.) via different networks, and what restrictions or restraints should be placed on services or networks when interworking (e.g., to accommodate accounting, timing and signalling, features)?
iv) What methods should be recommended for accessing one network from another?
v) How should conversions be accomplished (e.g., data to data, voice to data)?
vi) What arrangements or procedures are needed to accommodate the accounting function for a connection involving mixed networks?
vii) What influence would different national applications of service integration have on the international network with regard to interworking?

viii) What special problems arise from the use of ISDN to interconnect networks carrying services to existing standard terminal interfaces?

ix) What are the possibilities of application of service bits allocated in primary PCM and higher order digital systems in national and international digital networks?

Point E. Guidelines to facilitate evolution towards ISDN

Which strategy should be followed in order to facilitate and speed up the establishment of a worldwide ISDN?

Note: It should be taken into consideration that, in the introductory period, it will be necessary to establish an all-digital network mainly for the needs of "business subscribers" who represent only a small percentage of the overall number of subscribers but who orginate a substantial portion of the traffic. It may be useful to create a digital "overlay network" in each country and to interconnect these national networks by digital links.

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15. ABSTRACT (*A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.*)

The possibility of an Integrated Services Digital Network (ISDN) encircling the globe by the year 2000 is of increasing interest to the worldwide telecommunication community--developers, carriers, manufacturers, and users. Accelerating telecommunication and computer technologies, coupled with the information explosion and parallel market demands for information services, are generally seen to be the prime movers. The International Telegraph and Telephone Consultative Committee (CCITT), always concerned with the development of Recommendations which will aid in international telecommunication connectivity, has put its major emphasis during the present study period, 1981-1984, on the ISDN. The U.S. telecommunication industry is showing great interest in the work of the CCITT, anticipating strong effects of the developing standards on the U.S. market. This report presents a survey of the CCITT and of its role in the study and evolution of the proposed, worldwide, telephony-based ISDN.

16. Key Words (*Alphabetical order, separated by semicolons*)

CCITT; CCITT Recommendations; CCITT Standardized Services; ISDN; Study Group XVIII; telecommunications; telecommunication standards; U.S. CCITT

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